Project Manual

for

Tomball High School Multi – Program Activity Center

for the

Tomball Independent School District

10/30/2026

PBK Project No.: 25046901 Tomball HS

Issue for Proposal

TOMBALL ISD
DESTINATION EXCELLENCE

PBK

DOCUMENT 00 00 10 - TABLE OF CONTENTS

DIVISION 0 - GENERAL CONDITIONS

Date	*Section No.*	*Title*
10/30/2026	00 00 00	Project Manual Cover Sheet
10/30/2026	00 00 01	Seals Page
10/30/2026	00 00 10	Table of Contents
		Tomball ISD Documents

DIVISION 1 - GENERAL REQUIREMENTS

Date	*Section No.*	*Title*
10/23/2026	01 10 00	Summary
10/23/2026	01 21 00	Structural Allowances
10/23/2026	01 22 00	Unit Prices
10/23/2026	01 23 00	Alternates
10/23/2026	01 25 13	Product Substitution Procedures
10/23/2026	01 26 00	Contract Modification Procedures
10/23/2026	01 29 00	Payment Procedures
10/23/2026	01 29 73	Schedule of Values
10/23/2026	01 31 00	Project Management and Coordination
10/23/2026	01 33 00	Submittal Procedures
10/23/2026	01 40 00	Quality Requirements
10/23/2026	01 45 23	Structural Testing and Inspection Services
07/02/2026	01 45 23.1	Testing and Inspection Services
10/23/2026	01 50 00	Temporary Facilities and Controls
10/23/2026	01 57 13	General Source Controls
10/23/2026	01 57 13.13	Filter Fabric Fence
10/23/2026	01 57 13.14	Reinforced Filter Fabric Barrier
10/23/2026	01 57 13.15	Stabilized Construction Exit
10/23/2026	01 57 26	Texas Pollution Discharge Elimination System (TPDES)
10/30/2026	01 60 13	Exterior Design Selection
10/23/2026	01 77 00	Closeout Procedures
10/23/2026	01 77 01	Closeout Forms A-D
10/23/2026	01 78 39	Project Record Documents
10/23/2026	01 79 00	Demonstration and Training

DIVISION 2 - EXISTING CONDITIONS

Date	*Section No.*	*Title*
10/23/2026	02 32 00	Geotechnical Report
10/23/2026	02 41 13.23	Abandon Existing Utilities

DIVISON 3 - CONCRETE

Date	*Section No.*	*Title*
10/23/2026	03 05 80	Under-Slab Vapor Retarder
10/23/2026	03 10 00	Concrete Forming and Accessories
10/23/2026	03 11 31	Void Forms
10/23/2026	03 15 13	Waterstops
10/23/2026	03 20 00	Concrete Reinforcing
10/23/2026	03 30 00	Cast-in-Place Concrete
10/23/2026	03 52 16	Lightweight Insulating Concrete Deck System

DIVISION 4 – MASONRY

Date	*Section No.*	*Title*
10/30/2026	04 20 00	Unit Masonry – Face Brick
10/23/2026	04 22 00	Concrete Unit Masonry

DIVISION 5 – METALS

Date	*Section No.*	*Title*
10/23/2026	05 12 00	Structural Steel Framing
10/23/2026	05 21 00	Steel Joist Framing
10/23/2026	05 31 13	Steel Floor Decking
10/23/2026	05 31 23	Steel Roof Decking
10/23/2026	05 51 00	Steel Stairs, Handrails, Railings
10/30/2026	05 51 33.33	Aluminum Ships Ladder
10/30/2026	05 51 36	Metal Stairs

DIVISION 6 - WOOD, PLASTICS, AND COMPOSITES

Date	*Section No.*	*Title*
10/23/2026	06 10 00	Rough Carpentry
10/23/2026	06 16 00	Sheathing
10/23/2026	06 20 00	Finish Carpentry and Millwork

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Date	*Section No.*	*Title*
10/23/2026	07 16 00	Below Grade Waterproofing
10/23/2026	07 21 00	Thermal Insulation
10/30/2026	07 21 30	Pre-Engineered Building Insulation
10/23/2026	07 27 26	Fluid Applied Air Barrier System
10/23/2026	07 41 13	Prefinished Metal Roofing
10/30/2026	07 42 13	Metal Wall and Soffit Panels
10/30/2026	07 42 13.13	Metal Composite Wall Panels
10/23/2026	07 52 19	Modified Bitumen Membrane
10/23/2026	07 62 00	Roof Related Sheet Metal
10/23/2026	07 65 00	Flexible Flashing
10/23/2026	07 72 00	Roof Accessories
10/23/2026	07 72 33	Roof Scuttle
10/23/2026	07 81 00	Applied Fireproofing
10/23/2026	07 84 00	Firestopping
10/30/2026	07 91 00	Exterior Wall Joint Seals
10/23/2026	07 92 00	Joint Sealants
10/30/2026	07 95 00	Watertight Roof Expansion Joint System

DIVISION 8 – OPENINGS

Date	*Section No.*	*Title*
10/23/2026	08 11 13	Hollow Metal Doors and Frames
10/23/2026	08 31 13	Access Doors and Frames
10/23/2026	08 33 23	Overhead Coiling Doors
10/23/2026	08 41 13	Aluminum Framed Entrances and Storefronts
10/23/2026	08 44 13	Glazed Aluminum Curtain Walls
10/23/2026	08 71 00	Door Hardware
10/23/2026	08 80 00	Glazing
10/23/2026	08 83 00	Mirrors
10/30/2026	08 92 00	Louvered Equipment Enclosure

DIVISION 9 – FINISHES

Date	*Section No.*	*Title*
10/23/2026	09 21 16	Gypsum Wallboard Systems
10/23/2026	09 22 26.23	Metal Suspension Systems
10/23/2026	09 30 13	Ceramic Tiling
10/23/2026	09 30 19	Porcelain Tile
10/23/2026	09 51 00	Acoustical Ceiling Panels
10/23/2026	09 65 13	Resilient Base
10/23/2026	09 68 00	Carpeting
10/23/2026	09 90 00	Paintings and Coatings
10/23/2026	09 96 00	High Performance Coatings
10/23/2026	09 97 23	Concrete and Masonry Coatings

DIVISION 10 – SPECIALTIES

Date	*Section No.*	*Title*
10/23/2026	10 14 00	Graphics
10/23/2026	10 21 17	Solid Phenolic Toilet Compartments
10/23/2026	10 28 13	Toilet Accessories
10/23/2026	10 44 00	Fire Extinguishers and Cabinets
10/23/2026	10 73 13	Aluminum Canopy

DIVISION 11 – EQUIPMENT

Date	*Section No.*	*Title*
10/23/2026	11 65 00	Gymnasium and Field Play Equipment
10/23/2026	11 66 23	Athletic Netting
10/23/2026	11 66 23.53	Wall Padding

DIVISION 12 – FURNISHINGS

Date	*Section No.*	*Title*
10/23/2026	12 11 00	Digitally-Printed Vinyl Murals
10/23/2026	12 24 00	Window Shades

DIVISION 13 - SPECIAL CONSTRUCTION

Date	*Section No.*	*Title*
10/23/2026	13 34 19	Metal Building Systems

DIVISION 14 – CONVEYING SYSTEMS – NOT USED

DIVISION 21 - FIRE SUPPRESSION

Date	*Section No.*	*Title*
10/23/2026	21 05 00	Common Work Results for Fire Protection
10/23/2026	21 05 29	Hangers and Supports for Fire Suppression System
10/23/2026	21 05 48.13	Vibration Controls for Fire-Suppression System
10/23/2026	21 11 13	Fire Suppression Systems
10/23/2026	21 30 00	Fire Pumps and Equipment

DIVISION 22 - PLUMBING

Date	*Section No.*	*Title*
10/23/2026	22 05 00	Common Work Results for Plumbing
10/23/2026	22 05 16	Expansion Fittings and Loops for Plumbing Piping
10/23/2026	22 05 29	Plumbing Hangers and Supports
10/23/2026	22 05 48.13	Vibrations Controls for Plumbing Piping and Equipment
10/23/2026	22 11 16	Domestic Water Piping
10/23/2026	22 13 16	Sanitary Waste and Vent Piping
10/23/2026	22 14 13	Storm Drainage Piping
10/23/2026	22 20 23	Gas Piping
10/23/2026	22 30 00	Plumbing Equipment
10/23/2026	22 40 00	Plumbing Fixtures

DIVISION 23 - MECHANICAL

Date	*Section No.*	*Title*
10/23/2026	23 05 00	Common Work Results for HVAC
10/23/2026	23 05 13	Common Motor Requirements for HVAC Equipment
10/23/2026	23 05 14	Variable Frequency Drives
10/23/2026	23 05 16	Expansion Fittings and Loops for HVAC Piping
10/23/2026	23 05 19	Meters and Gages for HVAC Piping
10/23/2026	23 05 23	General-Duty Valves for HVAC Piping
10/23/2026	23 05 29	Hangers and Supports for HVAC Piping and Equipment
10/23/2026	23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment
10/23/2026	23 05 53	Identification for HVAC Piping and Equipment
10/23/2026	23 05 93	Testing, Adjusting and Balancing for HVAC

10/23/2026	23 07 13	Duct Insulation
10/23/2026	23 07 16	HVAC Equipment Insulation
10/23/2026	23 07 19	HVAC Piping Insulation
10/23/2026	23 08 00	Commissioning of HVAC Systems
10/23/2026	23 09 23	Direct Digital Control Systems for HVAC
10/23/2026	23 09 23.18	Carbon Monoxide Monitoring System
10/23/2026	23 09 93	Sequences of Operations of HVAC
10/23/2026	23 21 13	Hydronic Piping
10/23/2026	23 21 23	Hydronic Pumps
10/23/2026	23 25 13	Water Treatment for Closed-Loop Hydronic Systems
10/23/2026	23 25 19	Flushing and Cleaning of Hydronic Piping Systems
10/23/2026	23 31 13	Metal Ducts
10/23/2026	23 31 18	Fabric Duct
10/23/2026	23 33 00	Air Duct Accessories
10/23/2026	23 33 19	Duct Silencers
10/23/2026	23 34 00	HVAC Fans
10/23/2026	23 37 13	Diffusers, Registers and Grilles
10/23/2026	23 51 00	Breechings, Chimneys, and Stacks
10/23/2026	23 52 16	Condensing Boiler
10/23/2026	23 64 27	Rotary-Screw Water Chillers Air-Cooled
10/23/2026	23 73 13.19	Custom Indoor Central-Station Air Handling Units
10/29/26	23 74 13	Package Outdoor Central Station Air Handling Units
10/23/2026	23 81 26.16	Ductless Mini-Split Systems Air Conditioners
10/23/2026	23 82 19.13	Fan Coil Units

DIVISION 26 - ELECTRICAL

Date	*Section No.*	*Title*
10/23/2026	26 05 00	Common Work Results for Electrical
10/23/2026	26 05 19	Low Voltage Electrical Power Conductors and Cables
10/23/2026	26 05 26	Grounding and Bonding for Electrical Systems
10/23/2026	26 05 29	Hangers and Supports for Electrical Systems
10/23/2026	26 05 33	Raceway and Boxes for Electrical Systems
10/23/2026	26 05 53	Identification for Electrical Systems
10/23/2026	26 05 73.19	Arc-Flash Hazard Analysis
10/23/2026	26 08 00	Commissioning of Electrical Systems
10/23/2026	26 09 23	Lighting Control Devices
10/23/2026	26 09 43	Digital Lighting Controls – Non Networked
10/23/2026	26 20 00	Electrical Distribution Equipment
10/23/2026	26 27 26	Wiring Devices
10/23/2026	26 43 00	Surge Protection Devices For Low Voltage Electrical Power Circuits
10/23/2026	26 50 00	Lighting
10/23/2026	26 56 68	Exterior Athletic Lighting

DIVISION 27 - TECHNOLOGY & AUDIO VISUAL

Date	*Section No.*	*Title*
10/23/2026	27 05 00	Common Work Results for Communications
10/23/2026	27 10 00	Category 6 Structured Cabling System
10/23/2026	27 41 00	Audio-Visual Systems
07/02/2026	*27 41 16*	*Integrated Audio-Visual Systems*
10/23/2026	27 51 23	Intercommunications and Program Systems

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

Date	*Section No.*	*Title*

10/23/2026 28 05 00 General Electronic Safety Systems Requirements
07/02/2026 28 13 00 Access Control System
10/23/2026 28 23 00 Security Camera System
10/23/2026 28 31 00 Fire Detection and Notification System
10/23/2026 28 50 00 Personal Vaporizer Detection System

DIVISION 31 – EARTHWORK

Date	*Section No.*	*Title*
10/23/2026	31 11 00	Clearing and Grubbing
10/23/2026	31 13 13.13	Waste Material Disposal
10/23/2026	31 20 00	Earthwork
10/23/2026	31 23 00	Construction of Underground Utilities
10/23/2026	31 23 23.13	Bank Sand Backfill
10/23/2026	31 23 23.16	Cement Stabilized Sand Bedding and Backfill
10/23/2026	31 32 13.19	Lime Stabilized Subgrade
10/23/2026	31 32 13.20	Hydrated Lime and Lime Slurry
10/23/2026	31 32 13.21	Lime-Fly Ash Stabilized Subgrade
10/23/2026	31 41 00	Trench Safety
10/23/2026	31 50 00	Excavation Support and Protection
10/23/2026	31 63 29	Drilled Concrete Piers and Shafts

DIVISION 32 – EXTERIOR IMPROVEMENTS

Date	*Section No.*	*Title*
10/23/2026	32 05 19.18	PVC Geomembrane Liner for Turf Systems
10/23/2026	32 11 23.23	Free-Draining Stone” Base for Synthetic Turf Systems
10/23/2026	32 13 13	Concrete Paving
10/23/2026	32 18 23.30	Infilled Monofilament Synthetic Turf System
10/30/2026	32 31 11	Gate Operators
10/30/2026	32 31 19	Wrought Iron Fences Gates
10/23/2026	32 92 13	Hydro-Mulch Seeding (General)
10/23/2026	32 92 23	Fertilizer
10/23/2026	32 92 23.16	Solid Sodding (Bermuda)

DIVISION 33 - UTILITIES

Date	*Section No.*	*Title*
10/23/2026	33 01 30.13	Sanitary Sewer TCEQ Manhole Requirements
10/23/2026	33 11 00	Water Distribution System (PVC)
10/23/2026	33 33 13	Sanitary Sewer Lines
10/23/2026	33 41 00	Storm Sewer and Appurtenances
10/23/2026	33 44 19	Storm Water Management
10/23/2026	33 46 16.34	Subdrainage System for Synthetic Turf Athletic Fields
10/23/2026	33 71 74	Electrical Utility Services - Underground

END OF DOCUMENT 00 00 10

Multi-Program Activity Centers
Tomball ISD
Tomball, Texas

DESIGN TEAM

Architecture (A)
PBK
14001 Dallas Parkway, Suite 400
Dallas, Texas 75240
Phone: (972) 233-1323

Structure (S)
KUBALA ENGINEERS
11 Greenway Plaza, Suite 1510
Houston, Texas 77046
Phone: (800)248-3674

Building Envelope (A)
BEAM PROFESSIONALS
11 Greenway Plaza, Suite 1510
Houston, Texas 77046
Phone: (713) 965 -0608

Graphics (A)
BLUERING GRAPHICS
11 Greenway Plaza, Suite 1510
Houston, Texas 77046
Phone: (713) 965 -0608

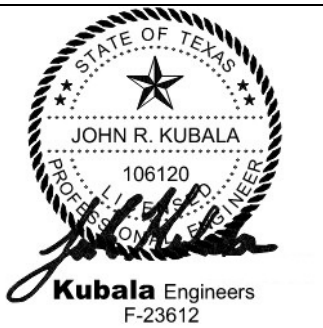
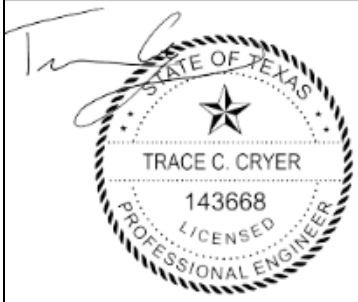
Audio Visual (AV)
TDG
191 Teal Lane
Kyle, Texas 78640
Phone: (512) 422-5156

MEP –Engineer of Record (MEPT)
LEAF Engineers
11 Greenway Plaza, Suite 1510
Houston, Texas 77046
Phone: (713) 965 -0608

Civil (C)
DIG Engineers
11 Greenway Plaza, Suite 1510
Houston, Texas 77046
Phone: (713) 965 -0608

Each specification section included herein is listed in the Project Manual Table of Contents with a letter code, indicated below, designating the Designer of Record responsible for its preparation, under whose seal and/or authority it is issued for the purpose(s) stated above. Seals and signatures do not apply to documents not included herein, nor (except as otherwise indicated) to documents prepared by the Owner or others ("O"), including but not necessarily limited to documents in Division 00, geotechnical and other reports, etc.

Architect of Record: Edmund X. Ramirez, RA Texas No. 14374 PBK Architects TX Firm: BR 1608	 October 30, 2026	(A) 14001 Dallas Parkway, Suite 400 Dallas, Texas 75240 Phone: (972) 233-1323
Engineer of Record, Mechanical Mital Patel, P.E. PE 111622 LEAF Engineers Firm Registration No. F-18672	 October 30, 2026	(M) 11 Greenway Plaza, 22nd Floor Houston, Texas 77046 Phone: (713) 940-3300
Engineer of Record, Electrical, Plumbing & Technology Matthew Sickorez, P.E. PE 107736 LEAF Engineers Firm Registration No. F- 18672	 October 30, 2026	(M), (P), (E) 11 Greenway Plaza, 22nd Floor Houston, Texas 77046 Phone: (713) 940-3300

Structural Engineer of Record: **John Kubala, P.E.** PE # Kubala Engineers TX Firm: 23612		(S) 11 Greenway Plaza, 22nd Floor Houston, Texas 77046 Phone: (713) 965 -0608
Civil Engineer of Record: **Trace Craig Cryer, PE** PE # 143668 DIG Engineers Firm # F-18326		(C) 11 Greenway Plaza, 22nd Floor Houston, Texas 77046 Phone: (713) 965 -0608

END OF SECTION 00 20 00

TOMBALL INDEPENDENT SCHOOL DISTRICT

RFP-CSP #1006 - 26 Issued: October 5, 2026

REQUEST FOR COMPETITIVE SEALED PROPOSALS FOR TOMBALL HS MULTI-PROGRAM ACTIVITY CENTER (MPAC) FACILITY

I. INTRODUCTION 3

II. RFP ADVERTISEMENT, AVAILABILITY, AND DELIVERY 4

III. PROBABLE SCHEDULE OF EVENTS 5

IV. SUBMISSION FORMAT & CONTENT REQUIREMENTS 6

V. DEFINITIONS 8

VI. TERM OF CONTRACT 8

VII. SUBMISSION REQUIREMENTS 8

VIII. AMENDMENTS TO THE RFP 15

IX. RESTRICTIONS ON COMMUNICATION 15

X. EVALUATION 15

XI. AWARD OF CONTRACT AND RESERVATION OF RIGHTS 17

XII. PROPOSAL MODIFICATIONS AND WITHDRAWAL PRIOR TO PROPOSAL OPENING 18

XIII. EXHIBIT A –PROPOSAL FORM 19

XIV. EXHIBIT B – BID BOND 22

XV. EXHIBIT C - FELONY CONVICTION NOTIFICATION 25

XVI. EXHIBIT D - ACKNOWLEDGMENT FORM - NON-COLLUSION STATEMENT 27

XVII. EXHIBIT E – PROOF OF INSURABILITY 28

XVIII. EXHIBIT F – PROOF OF BONDING CAPACITY 29

XIX. EXHIBIT G - SIGNATURE PAGE AND DECLARATION OF COMPLIANCE 30

XX. EXHIBIT H - DEVIATION AND EXCEPTIONS FORM 32

XXI. EXHIBIT I – CERTIFICATE OF RESIDENCY 33

XXII. EXHIBIT J - VENDOR STATEMENT OF DEBARMENT/SUSPENSION 34

XXIII. EXHIBIT K – REQUEST FOR TAXPAYER IDENTIFICATION NUMBER 35

XXIV. EXHIBIT L – FORM 1295-CERTIFICATE OF INTERESTED PARTIES 36

XXV. EXHIBIT M – CERTIFICATION REGARDING TERRORIST ORGANIZATIONS AND BOYCOTT OF ISRAEL 38

XXVI. EXHIBIT N – CERTIFICATION REGARDING BOYCOTTING CERTAIN ENERGY COMPANIES 39

XXVII. EXHIBIT O – CERTIFICATION PROHIBITING DISCRIMINATION AGAINST FIREARM AND AMMUNITION INDUSTRIES 40
XXVIII. EXHIBIT P – CERTIFICATION REGARDING CERTAIN FOREIGN-OWNED COMPANIES IN CONNECTION WITH CRITICAL INFRASTRUCTURE 41
XXIX. EXHIBIT Q – ANTITRUST CERTIFICATIONS STATEMENT (TEX. GOVERNMENT CODE § 2155.005) 43
XXX. EXHIBIT R – CONFLICT OF INTEREST DISCLOSURE STATEMENT 44
XXXI. EXHIBIT S – BID ALTERNATES AND UNIT PRICE FORM 46
XXXII. EXHIBIT T – KEY SUBCONTRACTORS 58
XXXIII. EXHIBIT U – PREVAILING WAGE RATES 59
XXXIV. EXHIBIT V – AIA DOCUMENT A101-2017, AND EXHIBITS 62
XXXV. EXHIBIT W - AIA DOCUMENT A201-2017 63

I. INTRODUCTION

A. Pursuant to the provisions of the Texas Government Code § 2269, Subchapter D, it is the intent of the Tomball Independent School District (hereinafter known as Owner) to solicit proposals from qualified vendors to provide Construction services in the process as described herein.

B. Project Team: The selected Respondent will join a Project Team which will include Owner Administration, Program Manager and Architect/Engineer, all of whom will be engaged in a cooperative effort to provide the Owner with successful and cost-effective solutions for a new Multi-Program Activity Center Facility.

C. Project Information: The Owner plans to build a new Multi-Program Activity Center Facility, approximately 72,000 sf. While the project is consolidated onto Tomball High School's campus, the facility will be located on an undeveloped portion of the Owner's property. The Project may include the following general scope items:

1. Site utilities, Concrete paving
2. Foundation/Footings
3. PEMB, Structural Frame
4. Metal fabrications
5. Masonry, face brick veneer
6. Metal wall and roof panels
7. Aluminum, glass and window wall
8. Modified Bitumen roofing
9. Synthetic Turf Installation
10. Interior Walls
11. Tile, resilient flooring, carpeting
12. Suspended drywall, lay-in panels, sound absorbing units
13. Steel doors and frames, wood doors, Overhead coiling doors
14. Specialties
15. Automatic sprinkler system
16. Detention, storm sewer utilities
17. Plumbing systems
18. Electrical, telecommunications systems and emergency power
19. HVAC Systems and building automation
20. Fire detection alarm and emergency call systems

D. The substantial completion date is stated in the proposal form

E. The Owner's estimated cost of construction $19,000,000.00.

F. ARCHITECT:

1. PBK Architects, 11 Greenway Plaza
Houston, TX 77070

G. PROGRAM MANAGER: (Owner's Representative)

1. Lockwood, Andrews & Newnam, Inc. • 3700 W. Sam Houston Pkwy. S • Suite 400 Houston, Texas 77042 • 713-266-6900

II. RFP ADVERTISEMENT, AVAILABILITY, AND DELIVERY

[Editors Note: Choose from one of the two options below regarding physical delivery of proposals or online-only delivery of proposals. Verify that you have addressed one-step or two-step submittal processes correctly in the case on online bids to allow the Projectmates software to have TWO SEPARATE BIDS. Have this section quality control checked by a peer]

A. Proposal/Contract Documents, including Drawings, Technical Specifications, and Addenda are available for download from Tomball ISD's website: https://www.tomballisd.net/about-tisd/departments/finance/purchasing/bids-and-proposals

B. Responses are due in two parts; Part 1: Price proposal and required Forms, Part 2: Alternates and Key Subcontractors. Responses are due as described in RFQ section III PROBABLE SCHEDULE OF EVENTS. All responses must be provided in a sealed envelope/package with RFP-CSP #1006 - 26 clearly printed on the face of the package and delivered to:

Attention: Zachary Boles, CFO
Tomball ISD Ancillary Services Building
RFP-CSP #1006-26 Tomball HS Muli-Program Activity Center (MPAC) Facility
1110 Baker Dr.
Tomball, TX 77375

C. Responses are due as described in RFQ section III PROBABLE SCHEDULE OF EVENTS

D. Questions concerning this RFP shall be directed to the Owner's Program Manager, in writing, to the email address below. Questions concerning the Contract Documents shall be addressed to the Architect, in writing, to the email address below. Verbal questions and explanations are not permitted other than as described by this section, if any. All questions are due as described in RFQ section III PROBABLE SCHEDULE OF EVENTS. Answers to questions will be issued in an Addendum by the Architect/Engineer for the Project and will be posted on the Owner's Website as described in RFQ section III PROBABLE SCHEDULE OF EVENTS.

Questions concerning the RFP
Owner's Program Manager Contact Person is:

Victor Fleming, CCM
Program Manager
Lockwood Andrews & Newnam, Inc.
FOR: Tomball Independent School District
1110 Baker Dr.
Tomball, TX 77375
Email: vcfleming@lan-inc.com

Questions concerning the Contract Documents
Architect's Contact Person is:

Mark Menchaca – Sr. Associate/Sr. Project Manager
PBK Architects
11 Greenway Plaza
Suite 350
Houston, TX 77070
Email: mark.menchaca@pbk.com

III. PROBABLE SCHEDULE OF EVENTS

- Tuesday, October 27, 2026 - Release Request for Proposals.

- Friday, October 30, 2026 - and Friday, November 6, 2026 – Advertisement Dates.

- Tuesday, November 10, 2026 @ 10:00 a.m. local time –Pre-Proposal Conference. The Pre-Proposal meeting agenda will include review of topics that may affect proper preparation and submittal of proposals. Attendance at the pre-proposal meeting is not mandatory, but all proposers are highly encouraged to attend. Immediately following the Pre-Proposal Conference there will be a site visit.

  Location of Pre-Proposal Conference:
  Tomball Ancillary Services Building
  1110 Baker Dr.
  Tomball, TX 77375

- Friday, November 13, 2026 @ 2:00 p.m. local time – Deadline for written requests for clarifications to the RFP or Construction Documents.

- Thursday, November 12, 2026 @ 2:00 p.m. local time – Completed Microsoft Excel file in response to part VII.D.2 and VII.D.3 due. Email reference checks will be sent on this day.

- Wednesday, November 18, 2026 @ 2:00 p.m. local time – Final Addendum will be issued at this time.

- Tuesday, November 24, 2026 – Sealed Proposals due. Proposals received after the time and date set for the opening of proposals will not be accepted and will be returned unopened.

  - Part 1 Responses are due Tuesday, November 24, 2026 at 2 pm local time
  - Part 2 Responses are due Tuesday, November 24, 2026 at 3 pm local time

  Any Proposal received after such time will not be considered and will be returned unopened. Unsigned Proposals and/or Proposals received via Facsimile or Email will not be considered. Part 1 will be held unopened, and the names of Respondents withheld, by the Owner until the receipt of Part 2 responses. When Part 1 and Part 2 are received, pursuant to the

provisions of the Texas Government Code §2269.151, the Owner's staff will publicly open and read aloud the names of the respondents and monetary offer stated in the Proposals Part 1 and the Alternates stated in Part 2. Within Forty-five (45) days following the date of the opening, the proposals will be evaluated and ranked in relation to the selection criteria set forth herein. Award will be made utilizing the Evaluation Criteria as required by Texas Government Code §2269.154 and as stated herein. Respondents must provide all requested information; and failure to comply with any portion of the solicitation will be reflected in the evaluation process. Proposals that have been opened may not be changed for the purpose of correcting an error in the price. Other than price, a proposer may have the right to change any other error or mistake in the proposal as may be permitted by applicable law and subject to the approval of the Owner, unless such change would be in contravention of statutory or common law requirements or unless such change would give an unfair advantage to the proposer making such change.

- Wednesday, November 25, 2026 thru Wednesday, December 2, 2026 – Evaluation of Respondent Submittals to determine the highest ranked Respondent and determine the recommendation.

- Thursday, December 3, 2026 thru Tuesday, December 8, 2026 – Anticipated recommendation to the Board of Trustees for Award of Contract, and authorization of Superintendent or designee to enter into negotiations with the highest ranked Respondent

IV. SUBMISSION FORMAT & CONTENT REQUIREMENTS

A. The contents of the Respondent Proposal must be complete in description, concise in volume, and austere in form.

B. The Proposal should be in the format of a written report and should be prepared on 8-1/2" x 11" sheets (single-sided) unless noted below and bound with coil or three ring binding.

1. Part 1

a) One (1) original containing an executed version of the following

(1) VII.A Letter of Interest
(2) VII.B Executive Summary
(3) VII.C Submission Questionnaire
(4) VII.D Respondent Project Experience
(5) VII.E Personnel
(6) VII.F Additional Information
(7) VII.G Optional Information
(8) VII.H Financial Information
(9) EXHIBIT A –PROPOSAL FORM
(10) EXHIBIT B – BID BOND
(11) EXHIBIT C - FELONY CONVICTION NOTIFICATION
(12) EXHIBIT D - ACKNOWLEDGMENT FORM - NON-COLLUSION STATEMENT

(13) EXHIBIT E – PROOF OF INSURABILITY
(14) EXHIBIT F – PROOF OF BONDING CAPACITY
(15) EXHIBIT G - SIGNATURE PAGE AND DECLARATION OF COMPLIANCE
(16) EXHIBIT H - DEVIATION AND EXCEPTIONS FORM
(17) exhIBIT I – CERTIFICATE OF RESIDENCY
(18) EXHIBIT J - VENDOR STATEMENT OF DEBARMENT/SUSPENSION
(19) EXHIBIT K – REQUEST FOR TAXPAYER IDENTIFICATION NUMBER
(20) EXHIBIT L – FORM 1295-CERTIFICATE OF INTERESTED PARTIES
(21) EXHIBIT M – CERTIFICATION REGARDING TERRORIST ORGANIZATIONS AND BOYCOTT OF ISRAEL
(22) EXHIBIT N – Certification Regarding Boycotting Certain Energy Companies
(23) EXHIBIT O – Certification Prohibiting Discrimination Against Firearm and Ammunition Industries
(24) EXHIBIT P – Certification Regarding Certain Foreign-Owned Companies in Connection with Critical Infrastructure
(25) EXHIBIT Q – ANTITRUST CERTIFICATIONS STATEMENT (TEX. GOVERNMENT CODE § 2155.005)
(26) EXHIBIT R – CONFLICT OF INTEREST DISCLOSURE STATEMENT

b) Four (4) copies of above EXCEPT that EXHIBIT A –PROPOSAL FORM and Part 2 documents are not required to be included.

c) One (1) flash drive containing:

(1) PDF of items stated in section IV.B.1.a) EXCEPT that EXHIBIT A –PROPOSAL FORM and Part 2 documents are not required to be included.
(2) Completed Microsoft Excel File in response to part VII.D.2 and VII.D.3

2. Part 2

a) One (1) original containing an executed version of the following

(1) EXHIBIT S – BID ALTERNATES AND UNIT PRICE FORM
(2) EXHIBIT T – KEY SUBCONTRACTORS

C. It is not required to re-state each question in the response. However, provide section number, and outline level description of the response item since the evaluation criteria will rely on certain sections of the response.

D. Respondents may provide supplemental materials further describing their capabilities and experience.

E. Owner is a governmental body subject to the Texas Public Information Act. Proposals submitted to Owner as a result of this procurement solicitation may be subject to release as public information after contracts are executed or the procurement is terminated. If a Respondent believes that its Proposal, or parts thereof, may be exempted from disclosure under Texas law, the Respondent must specify page-by-page and line-by-line the parts of the Proposal which it believes are exempt. In addition, the Respondent must specify which exception(s) to the Texas Public Information Act are applicable and provide detailed reasons to substantiate the exception(s). Vague or general claims to confidentiality will not be accepted. Owner assumes no obligation or responsibility relating to the disclosure or nondisclosure of information submitted by Respondents.

1. The Owner strictly complies with all statutes, court decisions, and opinions of the Texas Attorney General with respect to disclosure of Respondent's information.
2. Any respondent wishing to maintain confidentiality of financial information must include a written request for same with the submission of the proposal.

V. DEFINITIONS

A. Respondent: The prime General Contractor company to join the Architect, Owner representatives and Program Manager to ensure optimal Cost Control, Scheduling, Phasing of Packages and Construction of Owner facilities.

B. Company: The prime General Contractor to join the Architect, Owner representatives and Program Manager to ensure optimal Cost Control, Scheduling, Phasing of Packages and Construction of Owner facilities.

C. Program Manager: The entity contracted by the Owner to provide overall fiduciary responsibilities and direct oversight of the contractor and A/E Team to ensure performance of actions contributing to the success of the owner's objective.

D. RFP: Request for Proposals

E. Owner: Tomball Independent School District

VI. TERM OF CONTRACT

A. A contract awarded in response to this RFP will be for General Contracting Services for Tomball HS Multi-Program Activity Center (MPAC) Facility. The Owner has defined project completion dates for the anticipated work.

VII. SUBMISSION REQUIREMENTS

A. Letter of Interest

B. Executive Summary

Each respondent must include an executive summary briefly highlighting the respondent's qualifications and shall include how the respondent is most qualified to meet the evaluation criteria.

C. Submission Questionnaire

Please provide the following information in the sequence and format prescribed by this questionnaire. Supplemental materials providing additional information may be provided in a separate format, but the information requested below is to be provided in this format. Failure to provide clear, transparent, non-elusive answers will be deemed non-responsive and scored accordingly.

1. Firm Information

a) Name of Firm
b) Address of Principal Office
c) Phone and Fax Number
d) Primary Individual (Point of Contact) for this RFP; name and email

2. Firm Organization

a) Form of Business Organization (corporation, partnership, individual, joint venture, other?)
b) How many years has your organization been in business in its current capacity?
c) How many years has your organization been in business under its present name? Under what other or former names has your organization operated?
d) If your organization is a corporation, answer the following: Date of incorporation, State of incorporation, President's name, Vice-President's name(s), Secretary's name, and Treasurer's name.
e) If your organization is a partnership, answer the following: Date of organization, Type of partnership (if applicable), and Name(s) of general partner(s).
f) If your organization is individually owned, answer the following: Date of organization, Name of owner.
g) If the form of your organization is other than those listed above, describe it and name the principals.

D. Respondent Project Experience

1. Construction value

a) What is the construction dollar value, year by year, of all work under contract in all locations by your company for the period of 2021-2025?
b) What is the construction dollar value, year by year, of all work under contract in Texas by your company for the period of 2021-2025?
c) What is the construction dollar value, year by year, of all work under contract in Harris County and Montgomery County by your company for the period of 2021-2025?

d) What percentage of your company's total construction dollar value, year by year, does all work under contract in Harris County and Montgomery County by your company for the period of 2021-2025 represent?

e) What percentage of all work under contract in Harris County and Montgomery County by your company for the period of 2021-2025 has been K-12 school construction?

f) What is the full time equivalent (FTE) employee count in all Texas locations by your company for the period of 2021-2025?

g) What is the largest single executed contract value, year by year, by your company for the period of 2021-2025?

Section	2021	2022	2023	2024	2025
VII.D.1.a)					
VII.D.1.b)					
VII.D.1.c)					
VII.D.1.d)					
VII.D.1.e)					
VII.D.1.f)					
VII.D.1.g)					

2. Completed Work (through substantial completion) within the last thirty-six months: List K-12 school projects constructed by your organization in Texas. The Respondent is obligated to provide accurate contact information for contacting the persons named below during a survey process that will be used during the evaluation scoring. An oversized (11x17) table format concisely depicting all projects is required. Respondents must use the Microsoft Excel file available with this RFP. For each project, provide:

a) The Owner Entity

b) Name of the Project

c) State if the project was new construction, renovation, addition or combination

d) Type of construction contract (A101, A133, Owner Unique, etc.)

e) Nature of the project/function of the building (Eg. New High School with Career Tech programs, athletic complex and natatorium)

f) Size (SF)
g) Construction delivery method (CMAR, CSP, Hard Bid, Etc.)
h) Original contract (or GMP) cost
i) Final contract (or GMP) cost
j) Number of Change Orders (if any), either cost or time, (not change proposals, contingency expenditures or similar) with brief 150-word explanation, if desired
k) Bid date/Final GMP
l) Contractual original completion date
m) Actual completion date
n) Number of claims filed by contractor with brief explanation
o) Number of RFI's
p) Name of major subcontractors
q) Owner (Primary contact) contact information (If LAN was the Program Manager, do not list LAN as the Owner's Primary Contact):

(1) Name,
(2) title,
(3) email address,
(4) phone number

r) Architect contact information:

(1) Company name
(2) Name,
(3) title,
(4) email address,
(5) phone number

3. Current Work: List up to five (5) projects of similar size and scope currently under construction by your organization. List the projects in order of priority, with the most relevant project listed first. The Respondent is obligated to provide accurate contact information for contacting the persons named below during a survey process that will be used during the evaluation scoring. An oversized (11x17) table format concisely depicting all projects is required. Respondents must use the Microsoft Excel file available with this RFP. For each project, provide:

a) The Owner Entity
b) Name of the Project
c) State if the project is new construction, renovation, addition or combination
d) Type of construction contract (A101, A133, Owner Unique, etc.)
e) Nature of the project/function of the building (Eg. New High School with Career Tech programs, athletic complex and natatorium)
f) Size (SF)

g) Construction delivery method (CMAR, CSP, Hard Bid, Etc.)
h) Original contract (or GMP) cost
i) Current contract (or GMP) cost
j) Number of Change Orders (if any) through current period, either cost or time, (not change proposals, contingency expenditures or similar) with brief 150-word explanation, if desired
k) Bid date/Final GMP
l) Contractual completion date
m) Number of claims filed by contractor with brief explanation
n) Number of RFI's (To date)
o) Name of major subcontractors
p) Owner (Primary contact) contact information (If LAN was the Program Manager, do not list LAN as the Owner's Primary Contact):

(1) Name,
(2) title,
(3) email address,
(4) phone number

q) Architect contact information:

(1) Company name
(2) Name,
(3) title,
(4) email address,
(5) phone number

4. Contracting and Subcontracting:

a) List the List the categories of work that your organization normally performs with its own forces. Would you propose to do any work with your own forces?
b) List any subcontractors in which your organization has some ownership and list the categories of work those subcontractors normally perform.

5. Claims, Suits and Failure to Perform: (If the answer to any of the questions below is yes, please provide details). Note: Do not fail to respond to this question or furnish vague responses. Point totals available under this category of evaluation will be affected if you choose not to fully respond.

a) Has your organization ever failed to complete any work awarded?
b) Are there any judgments, claims, arbitration proceedings or suits, pending or outstanding against your organization or its officers?

c) Has your organization filed or been involved in any lawsuits or requested arbitration with regard to construction contracts within the last sixty months?

d) Within the last sixty months, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract?

6. Safety

a) Provide bidder's OSHA (Occupational Safety and Health Administration) inspection logs for the last three year

b) Provide a loss analysis from the bidder's insurance carrier

c) Provide a loss history covering all lines of insurance coverage carried by the bidder

E. Personnel

1. Provide an organizational chart outlining all personnel that will be assigned to the project and their responsibilities.

2. Given the scope and schedule of the project, identify the personnel proposed, specifically the Project Manager, Job Superintendent or Superintendent(s), and Field Operations personnel proposed to work on the project. Prior to contracting, the Owner may interview the Project Manager/Job Superintendent that will be assigned to the project. Please reference these personnel to projects listed in items VII.D.2 and VII.D.3 where possible.

a) Provide a resume and references for each individual stating

(1) Proposed role on this project

(2) Description of responsibilities for this proposed role (what will this person do?)

(3) Relevant past project experience list with role that makes this individual the best choice for this project (Client, cost, seasonal construction schedule, repairs, renovations, new construction, HVAC, etc.)

(4) General background information; education, years of experience, registrations, affiliations,

(5) Years of service with your company

(6) Prior two (2) employers and years of service with each

(7) Last three (3) completed or ongoing project assignments

(8) Contact information (Name, title, email address, phone number) for Owner's representative or Architect that could address questions regarding this individual for the last three (3) completed or ongoing projects

F. Additional Information

1. Letters of Recommendation: Furnish five (5) letters of recommendation from past or current K-12 Texas school district customers of the respondent, preferably from those projects listed in section VII.D.2and VII.D.3.

G. Optional Information

1. Furnish any additional content not requested by other sections of this RFP that demonstrates the qualifications of your company

H. Financial Information

1. Attach an audited financial statement, including your organization's latest balance sheet and income statement showing the following items:

a) Current assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory, and prepaid expenses).
b) Non-current assets (e.g., net fixed assets, other assets).
c) Current liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes).
d) Non-current liabilities (e.g., notes payable).
e) Capital accounts and retained earnings (e.g., capital, capital stock, authorized and outstanding shares par value, earned surplus, and retained earnings).
f) Name and address of firm preparing attached financial statement and date thereof.
g) Is the attached financial statement for the identical organization named under item VII.H.1 above? If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent subsidiary).
h) Will the organization whose financial statement is attached act as guarantor of the contract for construction?
i) Provide name, address and phone number of your financial institution.

2. Bonding

a) Provide Name of bonding company and name and address of agent.
b) Provide letter from bonding company stating the currently available bonding capacity of your company (Bonding limit minus current obligations)?

VIII. AMENDMENTS TO THE RFP

A. Changes, amendments, or written responses to questions received regarding this RFP will be posted on the Owner's website. It is the Respondent's responsibility to review this site and ascertain whether any amendments have been made prior to submission. No oral statement of any person shall modify or otherwise change or affect the terms, conditions or specifications stated in the RFP, and changes to the RFP – if any – shall be made in writing only.

IX. RESTRICTIONS ON COMMUNICATION

A. The Respondent's, or any agent or representative of Respondent shall not undertake any activities or actions to promote or advertise their qualifications or submission to any member of the Owner's Board of Trustees, the Owner's Administration or their respective staff persons, except as specifically requested in writing by to the named point of contact in section II.C at any time between the date of release of the RFP and the date of award of a contract by the Owner's Board of Trustees. This restriction extends to "thank you" letters, phone calls, emails and any contact that results in the direct or indirect discussion of the RFP and/or submission submitted by Respondent's. Violation of this provision by Respondent or his/her/its agent may lead to disqualification of his submission from consideration.

B. The Owner reserves the right to contact any Respondent for clarification after responses are opened and/or to further negotiate with any Respondent if such is deemed desirable by Owner.

X. EVALUATION

A. The Owner will conduct a comprehensive evaluation of all submissions received in response to this RFP. The Owner may appoint a selection committee to perform the evaluation.

B. Each submission will be analyzed to determine overall responsiveness, qualifications under the RFP and Respondent's cost proposal. Respondents will be scored based upon these criteria listed in this RFP. The Owner may request additional information from Respondent's at any time prior to final approval of a selected Respondent. Final approval of a selected Respondent(s) is subject to the action of the Board of Trustees of the Owner.

C. The Owner reserves the right to conduct all research it deems necessary as part of its evaluation of Respondent's including their previous clients.

D. The Owner will utilize the following criteria in the evaluation of responses:

Points Value	Category	Evaluation Method	Reference Section
35	Proposed Amount for Base Proposal and Owner-Selected Alternates	Respondent will receive an assigned share of the total available points in this category according to banded point categories shown in the "Table of Awarded Points". A formula will be used as follows to determine the award band for your proposal based on your percentage above the low bid: Percentage Above Low Bid=((Your combination of base price proposal and Owner-selected Alternates minus the minimum proposed combination of base price proposals and Owner-selected Alternates)/(minimum proposed combination of base price proposals and Owner-selected Alternates)). The result of the formula will be used to proportion the points awarded based on the "Table of Awarded Points"	XIII
10	Evaluation Survey of Company References and Project Contacts	Respondent's references and stated project contacts will be sent a request to participate in a survey of your company. The weighted average overall score for your company will be used to allocate a pro-rated share of the total available points in this category. If 4 or fewer responses are received, your company will earn fractional points for this category. You are responsible for accuracy of email address. A formula will be used as follows: ("Reference Factor" * points available in the category). "Reference Factor" is determined as follows: If 4 or fewer responses =((Your Firm Average Score - Min of all Firms) / (Max of all Firms - Min of all Firms)) * (number of responses * 20%) OR If 5 or more responses = (Your Firm Average Score - Min of all Firms) / (Max of all Firms - Min of all Firms). A minimum value not less than 20% of the available points will be awarded as a floor value. Note: by default, under the scoring above, one firm will earn all points and one firm will earn the points floor.	VII.D.2, VII.D.3
15	History of Company Performance	Respondent demonstrates consistent and average past and current workload to staff ratio, showing ability to adequately staff the work and company stability. Respondent shows no or little past history of claims, suits and failure to perform. Respondent shows low number of RFI Generated per project. Respondent shows ability to maintain cost with no cost increases. Positive safety record. Positive asset to liability ratio. Adequate bonding capacity. Strength of letters of reference.	VII.D.1, VII.D.2.n), VII.D.3.m), VII.D.5, VII.D.2.o), VII.D.3.n), VII.D.2.h), VII.D.2.i), VII.D.2.j), VII.D.3.h), VII.D.3.i), VII.D.6, VII.H.1, VII.H.2, VII.F.1
15	Similar Company Project Experience and Qualifications	Respondent company demonstrates similar company project experience by showing high proportion of Harris County and Montgomery County region work, projects of comparable cost, complexity and timeframe to the work in the RFP. Respondent demonstrates high proportion of past experience with subcontractors named in proposal.	VII.D.1, VII.D.2, VII.D.2.p), VII.D.3.o), VII.D.3, VII.D.4, XXXII

20	Similar Individual Personnel Project Experience and Qualifications	Respondent individual personnel proposed for the work in the RFP demonstrate similar project experience by showing high proportion of Harris County and Montgomery County region work, projects of comparable cost, complexity and timeframe to the work in the RFP. Organizational approach to the project is clear.	VII.E.2.a), VII.E.1
5	Prior Positive Experience with Owner	Respondent will earn 2.5 points if no prior experience with Owner. Respondent will earn increased points for positive prior experience. Respondent will earn reduced points for negative prior experience	

Table of Awarded Points

The lowest price receives the maximum points, with others receiving points based on a percentage comparison with the lowest cost proposed.

XI. AWARD OF CONTRACT AND RESERVATION OF RIGHTS

A. The Form of Contract will be AIA Document A101 - 2017, attached in Section XXXV, including incorporated reference files.

B. The Contract, if awarded, will be awarded to the Respondent whose Submission is deemed most advantageous to the Owner, upon approval of the Owner's Board of Trustees.

C. The Owner may accept any Submission in whole or in part. If subsequent negotiations are conducted, they shall not constitute a rejection or alternate RFP on the part of the Owner; however, final selection of a Respondent is subject to approval by the Owner's Board of Trustees.

D. The Owner reserves the right to accept one or more Submissions, or reject any or all Submissions received in response to this RFP, and to waive informalities and irregularities in the Submissions received. The Owner also reserves the right to terminate this RFP, and reissue a subsequent Solicitation, and/or remedy technical errors in the RFP Process.

E. This RFP does not commit the Owner to enter into a Contract, award any services related to this RFP, nor does it obligate the Owner to pay any costs incurred in preparation for submitting of the Submission for this RFP, or in anticipation of a Contract.

F. Access and Audit Rights: The Owner, or its authorized representative, shall be afforded unrestricted access to and permitted to inspect and copy all the respondent's records, which shall include but not be limited to accounting records (hard copy as well as computer readable data), correspondence, instructions, drawings, receipts, vouchers, memoranda and similar data relating to this Contract. The respondent shall preserve all such records for a period of five (5) years, or for such longer period as may be required by law, after final payment under this Contract. If this Contract is funded from contract/grant funds provided by the U.S. Government or the State of Texas, the Contract, books, and records shall be available for review and audit by the Comptroller General of the U.S. and/or the Inspector general of the federal sponsoring agency, or the State of Texas and its duly authorized representatives.

G. Appeal/Protest Process. Any respondent who submitted a proposal may appeal the Owner's award, if the appeal is based on deviations from laws, rules, regulations, or Owner policies. Owner Board Policy GF(Local) applies to any respondent wishing to appeal a proposal and/or award of a contract. In the event respondent is unsure about the award of

the contract, it is the Proposer's responsibility to contact the Owner on the next business day after the award is announced and verify details concerning the award.

XII. PROPOSAL MODIFICATIONS AND WITHDRAWAL PRIOR TO PROPOSAL OPENING

A. A Respondent may modify a Proposal by letter at any time prior to the submission deadline for receipt of Proposals. Modification requests must be received prior to the submission deadline. Modifications made before opening time must be initialed by Respondent guaranteeing authenticity. Proposals may not be amended or altered after the official opening with the single exception that any product literature and/or supporting data required by the actual specifications, if any, will be accepted at any time prior to the Owner's Board of Trustees consideration of same.

B. Likewise, any Respondent may modify a proposal by submitting a supplemental proposal in person prior to the scheduled closing time for receipt of proposals. Such supplemental proposal should mention only additions or subtractions to the original proposal so as to not reveal the final prices or terms to the Owner until the sealed proposal is open.

C. The Respondent or his duly authorized representative may withdraw a proposal by request, provided such request is received by Owner at the place designated for receipt of proposals and prior to the time fixed for the opening of proposals. The Proposal Bond will be returned with the proposals if withdrawn in accordance with the above. The withdrawal of a proposal does not prejudice the right of the Respondent to file a new proposal at the time and place stated.

XIII. EXHIBIT A –PROPOSAL FORM

Having examined the Request for Proposal prepared by the Owner, and in submitting this proposal, the undersigned agrees to the following:

1. To hold the proposal open for acceptance by the Owner for 60 days.
2. To hold alternate proposals open for acceptance by the Owner for 120 days
3. To execute Contract Documents within ten (10) days after the prescribed forms are presented for signature and give bond with good and sufficient surety or sureties, as may be required, for the faithful performance and proper fulfillment of such contract.
4. The Owner maintains the right to reject any or all proposals, to waive informalities or minor irregularities in the proposal process and to accept the proposal which the Owner considers most advantageous. The Owner reserves the right to verify the accuracy and completeness of all responses by utilizing any information available to the Owner without regard to whether such information appears in the submission.
5. That this Proposal has been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.
6. The Owner reserves the right to negotiate with any Respondent in a manner permitted by law.
7. The undersigned has reviewed the Contract and exhibits as modified by Owner and agrees to execute a final version of these contacts in accordance with the attached terms, subject to final approval by Owner.
8. By providing a response, each Applicant agrees to waive any claim it has or may have against the Owner, its Trustees, agents and employees, and any reference sources, arising out of or in connection with: the administration, evaluation, or recommendation of any response; waiver of any requirements in the Request for Proposals; acceptance or rejection of any response and award of the Contract.
9. The cost of developing a response is the sole responsibility of the Applicant. The Owner will not provide reimbursement of such cost, and will not be liable for any preparation cost for any reason whatsoever.
10. Respondent has visited the site of the proposed work and fully acquaint themselves with the existing conditions there and should fully inform themselves as to the facilities involved, the difficulties and restrictions attending the performance of the contract. The Respondent should thoroughly examine and familiarize themselves with the drawings, technical specifications and all other contract documents. The contractor by the execution of the contract shall in no way be relieved of any obligation under it due to his failure to receive or examine any form or legal document or to visit the site or acquaint themselves with the conditions there existing. The Owner will be justified in rejecting any claim based on lack of inspection of the site prior to the proposal.
11. The unit price, if requested, for each of the several items in the proposal shall include its pro rata share of overhead so that the sum of the products obtained by multiplying the quantity shown for each item by the unit price proposal represents the total proposal. Any proposal not conforming to this requirement may be rejected as informal. Special attention is drawn to this condition, as the unit prices will be used to determine the amount of any change orders resulting from an increase or decrease in quantities.

1. **Contract Time:** The undersigned agrees that, if the proposal is accepted, the Date of Commencement shall be established in a "Notice to Proceed" from the Owner and to obtain Substantial Completion of all work not later than May 5, 2028, subject to extensions of time as described in the Contract Documents.

2. **Construction Permit:** The undersigned acknowledges that the bid or proposal has been submitted with the understanding that the time from submission of the bid, or proposal until a building permit will be released is estimated as **90 calendar days**. The owner may issue a notice to proceed prior to the date when a building permit is released and the contractor shall commence all activities on the project for which a building permit is not required, such as project submittals, site mobilization, subcontractor buyout, and similar activities.

3. **Addenda:** The undersigned acknowledges receipt of:

Addenda 1 .....dated ..... _ _/_ _/_ _ _ _

Addenda 2 .....dated ..... _ _/_ _/_ _ _ _

Addenda 3 .....dated ..... _ _/_ _/_ _ _ _

Addenda 4 .....dated ..... _ _/_ _/_ _ _ _

Addenda 5 .....dated ..... _ _/_ _/_ _ _ _

4. **Base Proposal:** The undersigned agrees to perform the complete Work of this Project, for the lump sum price of (The Base Proposal includes all allowances listed in Section 01 21 00):

_____Dollars

(Amount written in words governs)

$_____(Amount in figures)

Submit with Part 1 **Company Name:**_____

Company:_____

Address:_____

City ST Zip

Telephone:_____ Fax:_____ Email:_____

Printed Name/Title:_____ Signature:_____

State whether firm is a: ❒ Corporation ❒ Partnership ❒ Individual

Submit with Part 1

XIV. EXHIBIT B – BID BOND

A bond in the amount of five (5) percent of the proposal issued by an acceptable surety licensed to do business in the State of Texas shall be submitted with each proposal. A certified check or bank draft payable to the Owner or negotiable U.S. Government Bonds (as par value) may be submitted in lieu of the Proposal Bond. Respondents are advised that performance and payment bonds are required for each project.

The bond or its comparable, will be returned to the Respondent as soon as practical after the opening of the proposals.

Furnish Bid Bond.

Submit with Part 1

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned, _____ as PRINCIPAL, and _____ _____, as SURETY are held and firmly bound unto _____ _____ hereinafter called the "Owner", in the penal sum of _____ _____ Dollars, ($_____), lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the Accompanying Bid, dated _____, for _____

NOW, THEREFOR, if the Principal shall not withdraw said Bid within the period specified therein after the opening of the same, or, if no period be specified, within sixty (60) days after the said opening, and shall within the period specified therefor, or if no period be specified, within ten (10) days after the prescribed forms are presented to him for signature, enter into a written contract with the Owner in accordance with the Bid as accepted, and give bond with good and sufficient surety or sureties, as may be required, for the faithful performance and proper fulfillment of such contract; or in the event of the withdrawal of said Bid within the period specified, or the failure to enter into such Contract and give such bond within the time specified, if the Principal shall pay the Owner the difference between the amount specified in said Bid and the amount for which the local Public Agency may procure the required work or supplies or both, if the latter be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS THEREOF, the above-bounded parties have executed this instrument under their several seals this _____ day of _____, the name and corporate seal of each corporate party being hereto affixed and these present signed by its undersigned representative, pursuant to authority of its governing body.

(SEAL)

_____

(SEAL)

Attest: By: _____

Affix

Corporate

Seal

Submit with Part 1

Attest: By: _____

Affix

Corporate

Seal

Attest: By: _____

Countersigned

By _____

* Attorney-in-Fact, State of _____

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the _____, _____, Secretary of the Corporation named as Principal in the within bond; that _____, who signed the said bond on behalf of the Principal was then _____ of said corporation; that I know his signature, and his signature thereto is genuine; and that said bond was duly signed, sealed, and attested to, for and in behalf of said corporation by authority of this governing body.

Corporate

Seal

Title: _____

* Power-of-attorney for person signing for surety company must be attached to bond.

Submit with Part 1

XV. EXHIBIT C - FELONY CONVICTION NOTIFICATION

State of Texas Legislative Senate Bill No.1, Section 44.034, Notification of Criminal History, Subsection (a) states "a person or business entity that enters into a contract with a school Owner must give advance notice to the Owner if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony."

Subsection (b) states "a school Owner may terminate a contract with a person or business entity if the Owner determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The Owner must compensate the person or business entity for services performed before the termination of the contract."

This notice is not required of a Publicly-held Corporation.

I, the undersigned agent for the company named below, certify that the information concerning notification of felony convictions has been reviewed by me and the following information furnished is true to the best of my knowledge.

Vendor's Name_____

Authorized Company Official's Name (Printed)_____

☐ My company is a publicly held corporation; therefore, this reporting requirement is not applicable: Signature of Company Official

_____

Submit with Part 1

☐ b. My company is not owned nor operated by anyone who has been convicted of a felony.
Signature of Company Official

_____

☐ c. My company is owned or operated by the following individual(s) who has/have been convicted of a felony:

Name of Felon(s)_____

Details of Conviction(s)_____

Signature of Company Official_____

Submit with Part 1

XVI. EXHIBIT D - ACKNOWLEDGMENT FORM - NON-COLLUSION STATEMENT

The undersigned affirms that they are duly authorized to execute this contract, that this company, corporation, firm, partnership or individual has not prepared this submission in collusion with any other Respondent, and that the contents of this submission as to prices, terms or conditions of said submission have not been communicated by the undersigned nor by any employee or agent to any other person engaged in this type of business prior to the official opening of this submission.

Vendor:_____

Address: _____

Phone: _____

Respondent (Signature):_____

Respondent (Print Name):_____

Position with Company:_____

Signature of CompanyOfficial_____

Authorizing Submission:_____

Company Official (Print Name):_____

Official Position: _____

Submit with Part 1

XVII. EXHIBIT E – PROOF OF INSURABILITY

Furnish proof of insurability from your insurance provider meeting the requirements set forth in the Contract, attached to this RFP. This can be in the form of a letter or other sample certificates attesting to the ability to comply with the insurance requirements.

Submit with Part 1

XVIII. EXHIBIT F – PROOF OF BONDING CAPACITY

Furnish proof of bonding capacity from your bonding agent stating the **bonding limits, current obligations and free bonding capacity** meeting the requirements set forth in the Contract Documents, attached to this RFP. This can be in the form of a letter.

Submit with Part 1

XIX. EXHIBIT G - SIGNATURE PAGE AND DECLARATION OF COMPLIANCE

Circle below to indicate the business structure of Respondent

Individual/Sole Proprietorship — Partnership or Joint Venture

Corporation — Other Entity (State Type)

The undersigned certifies that (s) he is _____(title) of the Respondent entity named below; that (s)he is authorized to sign this Submission Form (if a Corporation then by resolution with Certified Copy of resolution attached) for and on behalf of the entity, if any, named below, and that (s)he is authorized to execute same for and on behalf of and bind said entity to the terms and conditions provided for in the Submission as required by this RFP, and has the requisite authority to execute an Agreement on behalf of Respondent, if awarded, and that the 11-digit Comptroller's Taxpayer Number for the entity, if any, is:

11-digit Comptroller's Taxpayer Number Employer Identification Number: _____

Respondent Organization Name_____

By: _____

Printed Name: _____

Title: _____

By: _____

Submit with Part 1

(If Respondent is a Joint Venture, an authorized signature from a representative of each party is required)

Printed Name: _____

Title: _____

By signing this Signature Page and Declaration of Compliance, I do hereby declare that I have read the Request for Proposal on which our Submission is submitted with full knowledge of the requirements, and do hereby agree to furnish all services in full accordance with the requirements outlined in the Request for Proposal.

By signing and executing this submission, I further certify on behalf of my organization and represent to the Owner that Respondent has not offered, conferred or agreed to confer any pecuniary benefit, as defined by TEXAS PENAL CODE ANN.§ 218, or any other thing of value, as consideration for the receipt of information or any special treatment or advantage relating to this submission; the Respondent also certifies and represents that Respondent has not offered, conferred or agreed to confer a pecuniary benefit or other things of value as consideration for the recipients decision, opinion, recommendation, vote or other exercise of discretion concerning this submission; the Respondent certifies and represents that Respondent has neither coerced nor attempted to influence the exercise of discretion by any officer, trustee, agent or employee of the Owner concerning this submission on the basis of any consideration not authorized by law; the Respondent also certifies and represents that Respondent has not received any information not available to other Respondent so as to give the undersigned a preferential advantage with respect to this submission; the Respondent further certifies and represents that Respondent has not violated any state, federal or local law, regulation or ordinance relating to bribery, improper influence, collusion or the like and that Respondent will not in the future offer, confer, or agree to confer a pecuniary benefit or other thing of value to any officer, trustee, agent or employee of the Owner in return for the person having exercised the persons official discretion, power or duty with respect to this submission; the Respondent certifies and represents that it has not nor and will not in the future offer, confer, or agree to confer a pecuniary benefit or other thing of value to any officer, trustee, agent or employee of the Owner in connection with information regarding this submission, the submission of this submission, the award of this submission or the performance, delivery or sale pursuant to this submission.

Submit with Part 1

XX. EXHIBIT H - DEVIATION AND EXCEPTIONS FORM

All respondents are expected to fully comply with all Terms and Conditions of this RFP, including all dates noted, the AIA A101-2017 Standard Form of Agreement and the AIA A201-2017 General Conditions of the Contract for Construction as amended by the Owner. Any proposed deviations or exceptions to the Terms and Conditions of this RFP, including AIA documents, MUST be noted on this sheet. In the absence of any entry on this Deviation Form, the respondent assures the Owner of their full compliance with the Terms and Conditions of this RFP and the AIA documents.

Any exceptions to the modified AIA Contract Documents should be noted along with suggested wording for each exception. Owner will consider any such exceptions in its evaluation of the Proposer's proposal but is not obligated to accept any such exceptions or proposed modifications. If the Proposer and Owner are unable to resolve any exceptions to the mutual satisfaction of both parties, Owner reserves the right to reject the Proposer's proposal and award the Contract to another Proposer. Each Proposer, by making its proposal, represents that the Proposer has read, understands, and agrees to Owner's modifications to the AIA Documents. If a project is awarded to a Proposer and the Proposer requests changes to the Contract Documents, the Owner reserves the right to cancel the award and re-award the Project to an alternate Proposer. Requests to modify the terms of the Contract Documents during the pendency of this RFP will be denied.

Note that this deviation and exceptions form is NOT intended to note any deviations from the Construction Documents or Specifications and other information contained within the Project Manual. Any questions regarding those must be submitted in writing, per the terms of this RFP, and will be addressed accordingly in an Addenda.

The Owner will, at is sole discretion, determine whether the deviations listed below are acceptable. Furnish a description of the requested deviation, noting the impact that the proposed deviation will have on the cost and time of the project, if any, if accepted by the Owner. THIS DEVIATION FORM MUST BE SIGNED BY EACH RESPONDENT WHETHER THERE ARE DEVIATIONS LISTED OR NOT AND SUBMITTED WITH THIS PROPOSAL. THE PROPOSAL FURNISHED SHALL NOT BE QUALIFIED OR CONDITIONED IN ANY WAY ON ACCEPTANCE OF THE DEVIATIONS AND EXCEPTIONS LISTED BELOW.

DEVIATION:	Cost (+-)	Time (+-)

Respondent Organization Name_____

Authorized Signature_____

Submit with Part 1

XXI. EXHIBIT I – CERTIFICATE OF RESIDENCY

The State of Texas has passed a law concerning non-resident contractors. This law can be found in the Texas Government Code under Chapter 2252, Subchapter A. This law makes it necessary for the Owner to determine the residency of its bidders. In part, this law reads follows:

"Section: 2252.001
(3) 'Non-resident bidder' refers to a person who is not a resident.
(4) 'Resident bidder' refers to a person whose principal place of business in this state, including a

Contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Section 2252.002

"A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the greater of the following:

(1) the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located; or

(2) the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which a majority of the manufacturing relating to the contract will be performed."

I certify that_____
(Name of Company Bidding) is, under Section: 2252.001 (3) and (4),

_____Resident Bidder _____Non-resident Bidder

My or our principal place of business under Section: 2252.001 (3) and (4), is in the city of

_____ in the state of _____

_____
Signature of authorized Company Representative

_____
Print Name

_____ ___/___/___
Title Date

Submit with Part 1

XXII. EXHIBIT J - VENDOR STATEMENT OF DEBARMENT/SUSPENSION

I have read the conditions and specifications provided in the Request for Proposal document attached. I affirm, to the I have read the conditions and specifications provided in the Request for Qualifications document attached. I affirm, to the best of my knowledge, the company I represent has not been debarred or suspended from conducting business by the federal government or the State of Texas.

Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

Pursuant to applicable law, the contractor certifies that during the term of an award for all contracts by the Owner resulting from this procurement process, the contractor certifies that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation by any federal department or agency or by the State of Texas. Contractor shall immediately provide written notice to the Owner if at any time the contractor learns that this certification was erroneous when submitted or has become erroneous by reason of changed circumstances. The Owner may rely upon a certification of a contractor that the contractor is not debarred, suspended, ineligible, or voluntarily excluded from the covered contract, unless the Owner knows the certification is erroneous.

Name of Company/Firm: _____

Mailing Address: _____

City/State/Zip: _____

Email Address: _____

Prepare By: _____

Company Official's Name: _____
Printed

Company Official's Authorized Signature: _____

TITLE _____

TELEPHONE NUMBER_____ FAX NUMBER DATE _____

Submit with Part 1

XXIII. EXHIBIT K – REQUEST FOR TAXPAYER IDENTIFICATION NUMBER

Complete and submit Internal Revenue Service for "W-9"

Submit with Part 1

XXIV. EXHIBIT L – FORM 1295-CERTIFICATE OF INTERESTED PARTIES

Complete and submit Texas Ethics Commission Form 1295 at the Texas Ethics Commission web site at https://ethics.state.tx.us/forms/1295.pdf.

Certificate of Interested Parties (Form 1295 – must be filled out electronically with the Texas Ethics Commission's online filing application and attached to proposal)

Owner is required to comply with House Bill 1295, which amended the Texas Government Code by adding Section 2252.908, Disclosure of Interested Parties. Section 2252.908 applies to a contract of Owner that (1) requires an action or vote by the Owner Board of Trustees before the contract may be signed; (2) has a value of at least $1 million; or (3) is for services that would require a person to register as a lobbyist under Tex. Gov't Code Chapter 305. Section 2252.908 prohibits Owner from entering into a contract resulting from this RFP with a business entity unless the business entity submits a Disclosure of Interested Parties (Form 1295) to Owner at the time business entity submits the signed contract. Effective January 1, 2018, the Form 1295 requirement does not apply to: (1) a contract with a publicly traded business entity or wholly owned subsidiary of the same; (2) an electric utility; or (3) a gas utility. The Texas Ethics Commission has adopted rules requiring the business entity to file Form 1295 electronically with the Texas Ethics Commission. The following **definitions** apply:

(1) ***"Business Entity"*** means an entity recognized by law through which business is conducted, including a sole proprietorship, partnership, or corporation. TEX. GOV'T CODE § 2252.908(1).

(2) ***"Interested Party"*** means a person:
   a) who has a controlling interest in a business entity with whom Owner contracts; or
   b) who actively participates in facilitating the contract or negotiating the terms of the contract, including a broker, intermediary, adviser, or attorney for the business entity. TEX. GOV'T CODE § 2252.908(3).

(3) ***"Controlling interest"*** means:
   a) an ownership interest or participating interest in a business entity by virtue of units, percentage, shares, stock, or otherwise that exceeds 10 percent;
   b) membership on the board of directors or other governing body of a business entity of which the board or other governing body is composed of not more than 10 members; or
   c) service as an officer of a business entity that has four or fewer officers, or service as one of the four officers most highly compensated by a business entity that has more than four officers. *Subsection (c) does not apply to an officer of a publicly held business entity or its wholly owned subsidiaries.* TEX. ETHICS COMM. RULE 46.3(c).

(4) ***"Intermediary"*** means a person who actively participates in the facilitation of the contract or negotiating the contract, including a broker, adviser, attorney, or representative of or agent for the business entity who:
   a) receives compensation from the business entity for the person's participation;
   b) communicates directly with the governmental entity or state agency on behalf of the business entity regarding the contract; and
   c) is not an employee of the business entity. TEX. ETHICS COMM. RULE 46.3(e).

As a "business entity," all vendors must:

(1) **complete Form 1295 electronically** with the Texas Ethics Commission using the online filing application, which can be found at https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm
- **All vendors must complete Form 1295, even if no interested parties exist**
- In Section 2, insert "Tomball ISD"
- In Section 3, insert the "RFQ-CSP #1004 – 26" for this proposal

(2) **print a copy of the completed form** (make sure that it has a computer-generated certification number in the "Office Use Only" box)

(3) have an authorized agent of the business entity **sign the form**

(4) **submit** the completed Form 1295 by **attaching the form to your proposal.**

Submit with Part 1

OWNER must acknowledge the receipt of the filed Form 1295 by notifying the Texas Ethics Commission of the receipt of the filed Form 1295 no later than the 30th day after receipt by OWNER. After OWNER acknowledges the Form 1295, the Texas Ethics Commission will post the completed Form 1295 to its website with seven business days after receiving notice from OWNER.

Submit with Part 1

XXV. EXHIBIT M – CERTIFICATION REGARDING TERRORIST ORGANIZATIONS AND BOYCOTT OF ISRAEL

Respondent hereby certifies that it is not a company identified on the Texas Comptroller's list of companies known to have contracts with, or provide supplies or services to, a foreign organization designated as a Foreign Terrorist Organization by the U.S. Secretary of State under federal law. (Tex. Gov't Code §§ 2252.151-.154)

If (a) Respondent is not a sole proprietorship; (b) Respondent has ten (10) or more full-time employees; and (c) this Agreement has a value of $100,000 or more, the following certification shall apply; otherwise, this certification is not required. Pursuant to Chapter 2271 of the Texas Government Code, the Respondent hereby certifies and verifies that neither the Vendor, nor any affiliate, subsidiary, or parent company of the Respondent, if any (the "Respondent Companies"), boycotts Israel, and the Respondent agrees that the Respondent and Respondent Companies will not boycott Israel during the term of this Agreement. For purposes of this Agreement, the term "boycott" shall mean and include refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.

Name of Company/Firm: _____

Mailing Address: _____

City/State/Zip: _____

Email Address: _____

Prepare By: _____

Company Official's Name: _____
Printed

Company Official's Authorized Signature: _____

TITLE _____

TELEPHONE NUMBER_____ DATE _____

Submit with Part 1

XXVI. EXHIBIT N – CERTIFICATION REGARDING BOYCOTTING CERTAIN ENERGY COMPANIES

If (a) Vendor is not a sole proprietorship; (b) Vendor has ten (10) or more full-time employees; and (c) this Agreement has a value of $100,000 or more that is to be paid wholly or partly from public funds, the following certification shall apply; otherwise, this certification is not required. Pursuant to TEX. GOV'T CODE Ch. 2274 of SB 13 (87th session), Vendor hereby certifies and verifies that Vendor, or any wholly owned subsidiary, majority-owned subsidiary, parent company, or affiliate of these entities or business associations, if any, does not boycott energy companies and will not boycott energy companies during the term of the Agreement. For purposes of this Agreement, the term "company" shall mean an organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or limited liability company, that exists to make a profit. The term "boycott energy company" shall mean "without an ordinary business purpose, refusing to deal with, terminating business activities with, or otherwise taking any action intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company (a) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law, or (b) does business with a company described by paragraph (a)." See TEX. GOV'T CODE § 809.001(1).

Name of Company/Firm: _____

Mailing Address: _____

City/State/Zip: _____

Email Address: _____

Prepare By: _____

Company Official's Name: _____
Printed

Company Official's Authorized Signature: _____

TITLE _____

TELEPHONE NUMBER_____ DATE _____

Submit with Part 1

XXVII. EXHIBIT O – CERTIFICATION PROHIBITING DISCRIMINATION AGAINST FIREARM AND AMMUNITION INDUSTRIES

If (a) Vendor is not a sole proprietorship; (b) Vendor has at least ten (10) full-time employees; (c) this Agreement has a value of at least $100,000 that is paid wholly or partly from public funds; (d) the Agreement is not excepted under TEX. GOV'T CODE § 2274.003 of SB 19 (87th leg.); and (e) Owner has determined that Vendor is not a sole-source provider or Owner has not received any bids from a company that is able to provide this written verification, the following certification shall apply; otherwise, this certification is not required. Pursuant to TEX. GOV'T CODE Ch. 2274 of SB 19 (87th session), Vendor hereby certifies and verifies that Vendor, or association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or limited liability company, including a wholly owned subsidiary, majority-owned subsidiary parent company, or affiliate of these entities or associations, that exists to make a profit, does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association and will not discriminate during the term of this contract against a firearm entity or firearm trade association. For purposes of this Agreement, "discriminate against a firearm entity or firearm trade association" shall mean, with respect to the entity or association, to: "(1) refuse to engage in the trade of any goods or services with the entity or association based solely on its status as a firearm entity or firearm trade association; (2) refrain from continuing an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association; or (3) terminate an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association." See TEX. GOV'T CODE § 2274.001(3) of SB 19. "Discrimination against a firearm entity or firearm trade association" does not include: "(1) the established policies of a merchant, retail seller, or platform that restrict or prohibit the listing or selling of ammunition, firearms, or firearm accessories; and (2) a company's refusal to engage in the trade of any goods or services, decision to refrain from continuing an existing business relationship, or decision to terminate an existing business relationship to comply with federal, state, or local law, policy, or regulations or a directive by a regulatory agency, or for any traditional business reason that is specific to the customer or potential customer and not based solely on an entity's or association's status as a firearm entity or firearm trade association." See TEX. GOV'T CODE § 2274.001(3) of SB 19.

Name of Company/Firm: _____

Mailing Address: _____

City/State/Zip: _____

Email Address: _____

Prepare By: _____

Company Official's Name: _____
Printed

Company Official's Authorized Signature: _____

TITLE _____

TELEPHONE NUMBER_____ DATE _____

Submit with Part 1

XXVIII. EXHIBIT P – CERTIFICATION REGARDING CERTAIN FOREIGN-OWNED COMPANIES IN CONNECTION WITH CRITICAL INFRASTRUCTURE

Owner is prohibited from entering into a contract or other agreement relating to critical infrastructure that would grant to Vendor direct or remote access to or control of critical infrastructure in this state, excluding access specifically allowed by Owner for product warranty and support purposes. Vendor certifies that neither it nor its parent company nor any affiliate of Vendor or its parent company, is (1) owned by or the majority of stock or other ownership interest of the company is held or controlled by individuals who are citizens of China, Iran, North Korea, Russia, or a designated country; (2) a company or other entity, including governmental entity, that is owned or controlled by citizens of or is directly controlled by the government of China, Iran, North Korea, Russia, or a designated country; or (3) headquartered in China, Iran, North Korea, Russia, or a designated country. For purposes of this Agreement, "critical infrastructure" means "a communication infrastructure system, cybersecurity system, electric grid, hazardous waste treatment system, or water treatment facility." See TEX. GOV'T CODE § 2274.0101(2) of SB 1226 (87th leg.). Vendor verifies and certifies that Vendor will not grant direct or remote access to or control of critical infrastructure, except for product warranty and support purposes, to prohibited individuals, companies, or entities, including governmental entities, owned, controlled, or headquartered in China, Iran, North Korea, Russia, or a designated country, as determined by the Governor.

If Respondent is not a governmental body and (a) this Agreement has a stated expenditure of at least $1 million in public funds for the purchase of goods or services by the Owner; or (b) this Agreement results in the expenditure of at least $1 million in public funds for the purchase of goods or services by the Owner in a fiscal year of the Owner, the following certification shall apply; otherwise, this certification is not required. As required by Tex. Gov't Code § 552.374(b), the following statement is included in the RFP and the Agreement (unless the Agreement is (1) related to the purchase or underwriting of a public security; (2) is or may be used as collateral on a loan; or (3) proceeds from which are used to pay debt service of a public security of loan): "The requirements of Subchapter J, Chapter 552, Government Code, may apply to this RFP and Agreement and the contractor or vendor agrees that the contract can be terminated if the contractor or vendor knowingly or intentionally fails to comply with a requirement of that subchapter." Pursuant to Subchapter J, Chapter 552, Texas Government Code, the Respondent hereby certifies and agrees to (1) preserve all contracting information related to this Agreement as provided by the records retention requirements applicable to the Owner for the duration of the Agreement; (2) promptly provide to the Owner any contracting information related to the Agreement that is in the custody or possession of the Respondent on request of the Owner; and (3) on completion of the Agreement, either (a) provide at no cost to the Owner all contracting information related to the Agreement that is in the custody or possession of Respondent, or (b) preserve the contracting information related to the Agreement as provided by the records retention requirements applicable to the Owner.

Name of Company/Firm: _____

Mailing Address: _____

City/State/Zip: _____

Email Address: _____

Prepared By: _____

Company Official's Name: _____

Submit with Part 1

Printed

Company Official's Authorized Signature: _____

TITLE _____

TELEPHONE NUMBER_____ DATE _____

Submit with Part 1

XXIX. EXHIBIT Q – ANTITRUST CERTIFICATIONS STATEMENT (TEX. GOVERNMENT CODE § 2155.005)

I affirm under penalty of perjury of the laws of the State of Texas that:

1. I am duly authorized to execute this contract on my own behalf or on behalf of the company, corporation, firm, partnership or individual (Company) listed below;
2. In connection with this bid, neither I nor any representatives of the Company have violated any provision of the Texas Antitrust laws codified in Tex. Bus. & Comm. Code Chapter 15;
3. In connection with this bid, neither I nor any representative of the Company have violated any federal antitrust law; and
4. Neither I nor any representatives of the Company have directly or indirectly communicated any of the contents of this bid to a competitor of the Company or any other company, corporation, firm, partnership or individual engaged in the same line of business as the Company.

Name of Company/Firm: _____

Mailing Address: _____

City/State/Zip: _____

Email Address: _____

Prepared By: _____

Company Official's Name: _____
Printed

Company Official's Authorized Signature: _____

TITLE _____

TELEPHONE NUMBER_____ DATE _____

Submit with Part 1

XXX. EXHIBIT R – CONFLICT OF INTEREST DISCLOSURE STATEMENT

The Owner is required to comply with Texas Local Government Code Chapter 176, Disclosure of Certain Relationships with Local Government Officers. House Bill 23 significantly changed Chapter 176 as well as the required disclosures and the corresponding forms. As of September 1, 2015, any vendor who does business with the Owner or who seeks to do business with the Owner must fill out the new Conflict of Interest Questionnaire (CIQ) whether or not a conflict of interest exists. A conflict of interest exists in the following situations:

1. If the vendor has an employment or other business relationship with a local government officer of the Owner or a family member of the officer, as described by section 176.003(a)(2)(A) of the Texas Local Government Code; or
2. If the vendor has given a local government officer of the Owner, or a family member of the officer, one or more gifts with the aggregate value of $100, excluding any gift accepted by the officer or a family member of the officer if the gift is: (a) a political contribution as defined by Title 15 of the Election Code; or (b) a gift of food accepted as a guest; or
3. If the vendor has a family relationship with a local government officer of the Owner.

"Vendor" means a person who enters or seeks to enter into a contract with a local governmental entity. The term includes an agent of a vendor. The term includes an officer or employee of a state agency when that individual is acting in a private capacity to enter into a contract. The term does not include a state agency except for Texas Correctional Industries. *Texas Local Government Code 176.001(7).*

"Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on: (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity; (B) a transaction conducted at a price and subject to terms available to the public; or (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency. *Texas Local Government Code 176.001(3).*

"Family relationship" means a relationship between a person and another person within the third degree by consanguinity or the second degree by affinity, as those terms are defined by Subchapter B, Chapter 573, Government Code. *Texas Local Government Code 176.001(2-a).*

"Local government officer" means: (A) a member of the governing body of a local governmental entity; (B) a director, superintendent, administrator, president, or other person designated as the executive officer of a local governmental entity; or (C) an agent of a local governmental entity who exercises discretion in the planning, recommending, selecting, or contracting of a vendor. *Texas Local Government Code 176.001(4).*

Owner Board of Trustees include:
Mr. Mark Lewandowski, Mr. John McStravick, Dr. Michael Pratt, Mrs. Amanda Bass, Mrs. Jennifer Kratky, Mr. Coco White, Mr. Patrick Beecher

Owner Superintendent: Dr. Martha Salazar-Zamora

Current local government officers include, but are not limited to:
Dr. Amy Schindewolf, Dr. Michael Webb, Dr. Steven Gutierrez, Mrs. Holly Sherman, Mr. Zack Boles

If no conflict of interest exists, you must fill out Box 1 and type N/A on Box 3 of the CIQ form, sign and date it.
In the event of changed circumstances, an updated CIQ must be filed within seven (7) business days after the vendor becomes aware that a conflict of interest exists.

Submit with Part 1

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

(A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;

(B) a transaction conducted at a price and subject to terms available to the public; or

(C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

***

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds $2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than $100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

Form provided by Texas Ethics Commission www.ethics.state.tx.us Revised 1/1/2021

XXXI. EXHIBIT S – BID ALTERNATES AND UNIT PRICE FORM

Alternates: If the Owner elects to accept any or all of the Alternates, the undersigned agrees to modify the Base Proposal as stipulated. **Circle Add or Deduct** for each Alternate below.

Alternate NO. 1: Section 23 64 27 - Rotary-Screw Water Chillers - Owner will select one alternate from Alternates 1A – 1C to be included with the Base Proposal. **Do not** include Rotary-Screw Water Chillers in the Base Proposal.

Alternate NO. 1A: Provide Rotary-Screw Water Chillers as manufactured by **Carrier Corporation** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 1B: Provide Rotary-Screw Water Chillers as manufactured by **Trane Technologies, PLC** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 1C: Provide Rotary-Screw Water Chillers as manufactured by **JCI/York** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 2: Section 23 73 13.19 – Modular Central-Station Air-Handling Units - Owner will select one alternate from Alternates 2A – 2C to be included with the Base Proposal. **Do not** include Modular Central Station Air-Handling Units in the Base Proposal.

Alternate NO. 2A: Provide Custom Indoor Central-Station Air-Handling Units as manufactured by **Carrier Corporation** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 2B: Provide Custom Indoor Central-Station Air-Handling Units as manufactured by **Climate Craft and provided by Hunton Trane** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 2C: Provide Custom Indoor Central-Station Air-Handling Units as manufactured by **JCI/York** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 3: Section 23 74 13.16 – Packaged, Outdoor, Central-Station Air-Handling Units - Owner will select one alternate from Alternates 3A – 3C to be included with the Base Proposal. **Do not** include Packaged, Outdoor, Central-Station Air-Handling Units in the Base Proposal.

Alternate NO. 3A: Provide Packaged, Outdoor, Central-Station Air-Handling Units as manufactured by **Carrier Corporation** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 3B: Provide Packaged, Outdoor, Central-Station Air-Handling Units as manufactured by **Trane / Valent**, PLC as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 3C: Provide Packaged, Outdoor, Central-Station Air-Handling Units as manufactured by **JCI/York** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 4: Section 23 09 23 – Direct-Digital Controls - Owner will select one alternate from Alternates 4A – 4B to be included with the Base Proposal. **Do not** include Direct-Digital Control Devices for HVAC in the Base Proposal.

Alternate NO. 4A: Provide Direct-Digital Control Devices for HVAC as manufactured by **Automated Logic** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 4B: Provide Direct-Digital Control Devices for HVAC as manufactured by **Unify Energy Solutions** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 5: Section 23 52 16 – Condensing Boilers & 21 51 00 Breechings, Chimneys, and Stacks - Owner will select one alternate from Alternates 5A – 5 B to be included with the Base Proposal. **Do not** include Condensing Boilers and Breechings, Chimneys and Stacks in the Base Proposal.

Alternate NO. 5B: Provide Condensing Boilers as manufactured by **Hydrotherm – KN Series** and Breechings, Chimneys, and Stacks all from Goes Heating as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 5A: Provide Condensing Boilers as manufactured by **Camus - Avenger** and Breechings, Chimneys, and Stacks all from Delta T Equipment as specified and as shown on the drawings.

Add/Deduct_____Dollars
(Amount written in words governs)
$_____(Amount in figures)

Alternate NO. 6: Section 23 82 19.13 – Fan Coil Units - Owner will select one alternate from Alternates 6A – 6C to be included with the Base Proposal. **Do not** include Fan Coil Units in the Base Proposal.

Alternate NO. 6A: Provide Fan Coil Units as manufactured by **Carrier Corporation** specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 6B: Provide Fan Coil Units as manufactured by **Trane** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 6C: Provide Fan Coil Units as manufactured by **JCI / York** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 7: Section 23 81 26 – Ductless Mini-Split-System Air-Conditioners - Owner will select one alternate from Alternates 7A – 7B to be included with the Base Proposal. **Do not** include Fan Coil Units in the Base Proposal.

Alternate NO. 7A: Provide Ductless Mini-Split-System Air-Conditioners as manufactured by **Carrier Corporation** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 7B: Provide Ductless Mini-Split-System Air-Conditioners as manufactured by **Mitsubishi provided by Hunton Trane** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 8: Section 23 05 14 Variable Frequency Drives - Owner will select one alternate from Alternates 8A – 8C to be included with the Base Proposal. **Do not** include Fan Coil Units in the Base Proposal.

Alternate NO. 8A: Provide Variable Frequency Drives as manufactured by **ABB** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 8B: Provide Variable Frequency Drives as manufactured by **Danfoss** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 8C: Provide Variable Frequency Drives as manufactured by **Toshiba** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 9: Section 23 21 23 Hydronic Pumps - Owner will select one alternate from Alternates 9A – 9D to be included with the Base Proposal. **Do not** include Fan Coil Units in the Base Proposal.

Alternate NO. 9A: Provide Hydronic Pumps as manufactured by **Bell & Gossett** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 9B: Provide Hydronic Pumps as manufactured by **Pentair / Aurora** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 9C: Provide Hydronic Pumps as manufactured by **Armstrong** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 9D: Provide Hydronic Pumps as manufactured by **Taco** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 10: Section 26 50 00 Light Fixture Package - Owner will select one alternate from Alternates 10A – 10C to be included with the Base Proposal. **Do not** include Light Fixture Package in the Base Proposal. This alternate shall include batteries, drivers, generator transfer devices, fixture accessories, exit signs, parking poles / heads, wall packs, decorative supports or mountings as well as any wiring required to connect light fixtures to remote battery or driver. Alternate pricing shall also include any attic stock of fixtures or drivers listed in the project. This alternate shall not include the sports field lighting.

Alternate NO. 10A: Provide Light Fixture Package from **CW Lighting** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 10B: Provide Light Fixture Package from **Lesco** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 10C: Provide Light Fixture Package from **PSA** as specified and as shown on the drawings.
Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 11: Section 26 09 43 Digital Lighting Controls - Owner will select one alternate from Alternates 11A – 11C to be included with the Base Proposal. **Do not** include Digital Lighting Controls in the Base Proposal. This alternate shall include non-networked digital lighting system as detailed on plans and specifications. The alternate pricing shall include any wall switches, power packs, occupancy sensors, daylight harvesting sensors, handheld devices, relays, wiring and any accessors associated with a complete lighting control system. Alternate pricing shall include any attic stock listing in the project.

Alternate NO. 11A: Provide Digital Lighting Controls manufactured by **Dynalite** as specified and as shown on the drawings.

Add/Deduct _____Dollars

(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 11B: Provide Digital Lighting Controls manufactured by **Acuity** as specified and as shown on the drawings.

Add/Deduct _____Dollars

(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 11C: Provide Digital Lighting Controls manufactured by **Cooper Lighting Solutions** as specified and as shown on the drawings.

Add/Deduct _____Dollars

(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 12: Section 32 18 23.30 – Infilled Monofilament Synthetic Turf System - Owner will select one alternate from Alternates 12A – 12D to be included with the Base Proposal. **Do not** include Infilled Monofilament Synthetic Turf System for field turf in the Base Proposal.

Alternate NO. 12A: Provide Infilled Monofilament Synthetic Turf for the field turf as manufactured by **Hellas** as specified and as shown on the drawings.

Add/Deduct _____Dollars

(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 12B: Provide Infilled Monofilament Synthetic Turf for the field turf as manufactured by **AstroTurf** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 12C: Provide Infilled Monofilament Synthetic Turf for the field turf as manufactured by **FieldTurf** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 12D: Provide Infilled Monofilament Synthetic Turf for the field turf as manufactured by **Paragon** as specified and as shown on the drawings.

Add/Deduct _____Dollars
(Amount written in words governs)

$_____(Amount in figures)

Alternate NO. 13: Provide optional adjustment to Base Proposal.

Add/Deduct _____Dollars

(Amount written in words governs)

$_____(Amount in figures)

Unit Price: The undersigned further agrees that in case adjustments to the work or material is authorized from what is shown in the Contract the following unit prices will be used in adjusting the Contract Price. The Contract Price shall be subject to increase or decrease based upon the actually accepted quantities performed multiplied by the current contract unit prices. Work shall be in conformance with the Contract Documents. If unit price shall be used, then payment for all items will be on a unit price basis, unless listed otherwise in the Proposal Form. The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all Work required for each of the unit price items. Contract unit price multiplied by agreed quantity is full compensation and includes Overhead, field overhead, and profit.

Unit Price 1: ELECTRICAL DUPLEX RECEPTACLE

Provide unit price for a new 20A, 120V duplex electrical receptacle and cover plate, flush mounted in a CMU, metal stud, or demountable wall construction, circuited to an existing electrical panel within 150 feet of the outlet using a branch circuit consisting of 2 #10 AWG and 1 #10 AWG ground in ¾ inch EMT conduit. All conduits to be concealed in wall construction. Unit price shall include a 20 amp circuit breaker to be installed in existing panel space.

$_____each

UNIT PRICE 2: DATA DROP

Provide unit price for a data drop, flush mounted in a CMU, metal stud or demountable wall construction., wired to an IDF/MDF Room. The data drop shall consist of a single gang wall box, cabling wiring device, cover plate, 3/4 inch conduit from outlet to above accessible ceiling, plenum-rated cabling routed above accessible ceiling to the nearest MDF or IDF location within 250 feet of the outlet. Termination and testing to be included in the unit price.

$_____ each

UNIT PRICE 3: VOICE DROP

Provide unit price for a voice drop, flush mounted in a CMU, metal stud or demountable wall construction., wired to the telecommunications/MDF room. The voice drop shall consist of a single gang wall box, voice jack, cover plate, 3/4 inch conduit from outlet to above accessible ceiling, plenum-rated voice cable routed above accessible ceiling to telecommunication head end equipment. Termination and testing to be included in the unit price.

$_____ each

UNIT PRICE 4: 4 ½" THICK CONCRETE WALK PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 4 ½" thick concrete walk (minimum 100 SF) per Square Foot.

$_____ each

UNIT PRICE 5: 7" THICK CONCRETE DRIVE PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7" thick concrete drive (minimum 100 SF) per Square Foot.

$_____ each

UNIT PRICE 6: LIFE SAFETY DEVICES (including all associated cabling and programming)

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add /deduct Fire Alarm devices.

1. Exterior Horn To Speaker $_____ each
2. Interior Horn To Speaker $_____ each
3. Interior Visual Strobe $_____ each
4. Interior Speaker/Visual Strobe $_____ each
5. Smoke Detector $_____ each
6. Heat Detector $_____ each
7. Manual Pull Station $_____ each
8. Stopper 2 Pull Station Cover $_____ each
9. Annunciator Panel $_____ each
10. Duct Detector $_____ each
11. Relay $_____ each
12. Supervisory $_____ each
13. Waterflow $_____ each
14. Amplifier $_____ each
15. Remote Power Supply $_____ each

UNIT PRICE 7: EXIT SIGN

This unit cost shall establish the amount to be added to the contract price to provide and install one (1) exit sign. Price shall include wiring to nearest available emergency circuit, up to 200 feet.

$_____ each

UNIT PRICE 8: SECURITY FILM

This unit cost shall establish the amount to be added to the contract price to provide and install security film on existing exterior glazing (minimum 200 square feet).

1. Armor Glass $_____ Square foot
2. Saint Gobain $_____ Square foot
3. 3M $_____ Square foot

Unit Price NO. 9: Concrete Poured from Truck

Each cubic yard structural concrete, off the truck, no pumping, placement, or finishing. as required by construction documents.

$_____ Cubic yard

Unit Price NO. 10: Concrete Pumped

Each cubic yard structural concrete, as required by construction documents.

$_____ Cubic yard

Unit Price NO. 11: 24" Diameter Auger Cast Grout Piles

Each linear foot of 24" diameter auger cast grout piles complete including grout, accessories, & drilling.

$_____ Linear Foot

Unit Price NO. 12: Concrete Masonry Units

Each unit of concrete masonry units, as required by construction documents.

$_____ Units

Unit Price NO. 13: Reinforcing Steel, Straight or Bent

Pound weight of reinforcing steel, straight or bent, as required by the Contract Documents.

$_____ Pound

Unit Price NO. 14: Structural Steel

Pound weight of structural steel as required by the Contract Documents.

$_____ Ea.

Company:_____

Address:_____

City ST Zip

Telephone:_____ Fax:_____ Email:_____

Printed Name/Title:_____ Signature:_____

State whether firm is a: ❒ Corporation ❒ Partnership ❒ Individual

Submit with Part 2

Company Name:_____

XXXII. EXHIBIT T – KEY SUBCONTRACTORS

List the following top (3) Subcontractors for each discipline listed below providing their all-inclusive price to allow for a net add or deduct for the Owner's review. The number one sub-contractor shall be the one used within the base bid. Number two shall be the 2nd bidder and so on. The Owner reserves the right to select either of the three (3) or discards all to seek another Subcontractor or Vendor Bid.

Ranked Discipline		**Name of Company**	**Cost**
Concrete			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
PEMB – Provide lead time for manufacturing			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
Mechanical			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
Plumbing			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
Electrical			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
Fire Alarm			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
Building Automation			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____
Self-Performed Work			
List All Self-Performed Work. Provide Pricing for Subcontractors for the same Work Scope.			
	#1	_____	$ _____
	#2	_____	$ _____
	#3	_____	$ _____

Submit with Part 2

XXXIII. EXHIBIT U – PREVAILING WAGE RATES

Prevailing Wage Rate Determination Information

The following information is from Chapter 2258 Texas Government Code:

Sec. 2258.021. Right to be Paid Prevailing Wage Rates.

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
  (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
  (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
(b) Subsection (a) does not apply to maintenance work.
(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

Sec. 2258.023. Prevailing Wage Rates to be paid by Contractor and Subcontractor; Penalty.

(a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.
(b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, $60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
(c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.
(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

Sec. 2258.051. Duty of Public Body to Hear Complaints and Withhold Payment.

A public body awarding a contract, and an agent or officer of the public body, shall:

(1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
(2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

1 of 3

Submit with Part 2

Prevailing Wage Rates – School Construction Trades

June 2, 2025

Texas Gulf Coast Area

CLASSIFICATION	2025 HOURLY RATE
ASBESTOS WORKER	$27.20
BRICKLAYER; MASON	$24.90
CARPENTER; CASEWORKER	$23.13
CARPET LAYER; FLOOR INSTALLER	$26.20
CONCRETE FINISHER	$23.83
DATA COMM/TELE COMM	$24.33
DRYWALL INSTALLER; CEILING INSTALLER	$24.33
ELECTRICIAN	$29.86
ELEVATOR MECHANIC	$39.78
FIREPROOFING INSTALLER	$22.99
GLAZIER	$23.25
HEAVY EQUIPMENT OPERATOR	$22.17
INSULATOR	$21.95
IRONWORKER	$26.50
LABORER, HELPER	$19.81
LATHERER; PLASTERER	$22.75
LIGHT EQUIPMENT OPERATOR	$28.75
METAL BUILDING ASSEMBLER	$24.00
PAINTER; WALL COVERING INSTALLER	$20.17
PIPEFITTER	$29.82
PLUMBER	$27.98
ROOFER	$22.50
SHEET METAL WORKER	$29.96
SPRINKLER FITTER	$23.00
STEEL ERECTOR	$26.00
TERRAZZO WORKER	$22.75
TILE SETTER	$22.00
WATERPROOFER; CAULKER	$24.00

This document was developed by PBK Architects, Inc., in strict accordance with Chapter 2258 of the Texas Government Code.

2 of 3

Submit with Part 2

Prevailing Wage Rates
Worker Classification Definition Sheet

Asbestos Worker	Worker who removes & disposes of asbestos materials.
Bricklayers/Masons	Craftsman who works with masonry products, stone, brick, block or any material substituting for those materials & accessories.
Carpenter / Caseworker	Worker who builds wood structures or structures of any material which has replaced wood. Includes rough & finish carpentry, hardware and trim.
Carpet Layer / Floor Installer	Worker who installs carpets and/or floor coverings-vinyl tile.
Concrete Finisher	Worker who floats, trowels and finishes concrete.
Data Comm / Telecom Installer	Worker who installs data/telephone & television cable and associated equipment and accessories.
Drywall / Ceiling Installer	Worker who installs metal framed walls & ceilings, drywall coverings, ceiling grids & ceilings.
Electrician	Skilled craftsman who installs or repairs electrical wiring & devices. Includes fire alarm systems &HVAC electrical controls.
Elevator Mechanic	Craftsman skilled in the installation & maintenance of elevators.
Fire Proofing Installer	Worker who sprays or applies fire proofing materials.
Glazier	Worker who installs glass, glazing and glass framing.
Heavy Equipment Operator	Includes, but not limited to, all Cat tractors, all derrick-powered, all power operated cranes, back-hoe, back-filler, power operated shovel, winch truck, all trenching machines.
Insulator	Worker who applies, sprays or installs insulation.
Iron Worker	Skilled craftsman who erects structural steel framing & installs structural concrete Rebar.
Laborer / Helper	Worker qualified for only unskilled or semi-skilled work. Lifting, carrying materials & tools, hauling, digging, clean-up.
Lather / Plasterer	Worker who installs metal framing & lath. Worker who applies plaster to lathing and installs associated accessories.
Light Equipment Operator	Includes, but not limited to, air compressors, truck crane driver, flex plane, building elevator, form grader, concrete mixer (less than 14cf), conveyer.
Metal Building Assembler	Worker who assembles pre-made metal buildings.
Millwright	Mechanic specializing in the installation of heavy machinery, conveyance, wrenches, dock levelers, hydraulic lifts & align pumps.
Painter / Wall Covering Installer	Worker who prepares wall surfaces & applies paint and/or wall coverings, tape and bedding.
Pipefitter	Trained worker who installs piping systems, chilled water piping & hot water (boiler) piping, pneumatic tubing controls, chillers, boilers & associated mechanical equipment.
Plumber	Skilled craftsman who installs domestic hot & cold water piping, waste piping, storm system piping, water closets, sinks, urinals, and related work.
Roofer	Worker who installs roofing materials, Bitumen (asphalt & coal tar) felts, flashings, all types roofing membranes & associated products.
Sheet Metal Worker	Worker who installs sheet metal products. Roof metal, flashings & curbs, ductwork, mechanical equipment and associated metals.
Sprinkler Fitter	Worker who installs fire sprinkler systems & fire protection equipment.
Steel Erector	Worker who erects and dismantles structural steel frames of buildings and other structures
Terrazzo Worker	Craftsman who places & finishes Terrazzo.
Tile Setter	Worker who prepares wall and/or floor surfaces & applies ceramic tiles to these surfaces.
Waterproofer / Caulker	Worker who applies water proofing material to buildings. Products include sealant, caulk, sheet membrane, liquid membranes, sprayed, rolled or brushed.

END OF DOCUMENT

This document was developed by PBK Architects, Inc. in strict accordance with the Texas Government Code Chapter 2258.

XXXIV. EXHIBIT V – AIA DOCUMENT A101-2017, AND EXHIBITS

XXXV. EXHIBIT W - AIA DOCUMENT A201-2017

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Phased construction.
   4. Work by Owner.
   5. Work under separate contracts.
   6. Future Work.
   7. Purchase contracts.
   8. Owner furnished products.
   9. Owner furnished, Contractor installed products.
   10. Access to site.
   11. Coordination with occupants.
   12. Work restrictions.
   13. Specification and drawing conventions.
   14. Miscellaneous provisions.

1.3 PROJECT INFORMATION

A. Project Identification: Tomball High School
   1. Project Location: 118 Baker Drive, Tomball, Texas

B. Owner: Tomball Independent School District
   1. Owner's Representative: LAN, Program Manager

C. Architect: PBK Architects, Houston, Texas.

D. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following: Tomball Independent School District.

B. Project Components:
   1. One story building with drilled piers, slab-on-grade, steel frame, masonry cavity walls, brick veneer, and built-up roofing, and a PEMB Metal Building.
   2. This facility will include regular athletic lobby, indoor golf simulator, indoor practice facility, and ancillary support areas.
   3. On-site improvements and site amenities will include parking, entry canopies, utilities, and areas.

C. The Work:
   1. All work or portions of work necessary to provide a complete in-place, weathertight, structurally sound facility as represented in the Drawings and Specifications, including, but not

limited to civil sitework and utilities, architectural and structural building components, architectural finishes, food service equipment installation, mechanical equipment installation, mechanical ducting, plumbing piping and fixtures, electrical equipment and fixtures, fire alarm, security, technology and communications. Refer to mechanical specifications for connectivity and special requirements.

1.5 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

A. Cooperate fully with Owner so Work may be carried out smoothly, without interfering with or delaying the work or work by Owner. Coordinate the Work with Work performed by Owner.

B. Purchase Contracts: The Owner reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. The Owner, at their sole discretion, may assign these purchase contracts to Contractor. This assignment could include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
   1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.

C. Owner Furnished, Contractor Installed Products (OFCI): The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable.
   1. Owner Furnished Products: Coordinate with Owner.

1.6 ACCESS TO SITE

A. Use of Site: Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
   1. Limits: The drawings indicate the limits of the construction operations.
   2. Driveways, Walkways, and Entrances: Keep driveways. parking areas, student drop off and pick up points, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, the students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 COORDINATION WITH OCCUPANTS

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
   2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
   3. Before limited Owner occupancy, ensure mechanical and electrical systems are fully operational, and required tests and inspections and start up procedures are successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
   4. Upon occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction. Refer to General Conditions for any additional requirements.

B. On Site Work Hours: Limit Work in the existing building to normal working hours, Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
   1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
   2. Obtain Owner’s written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Owner not less than two weeks in advance of proposed disruptive operations.
   2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.

G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on site.
   1. Maintain list of approved screened personnel with Owner's representative.
   2. Contractor shall provide lists of names of all workers certifying they have been screened to be in compliance with state regulations regarding background checks.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 1 General Requirements: Requirements of Sections in Division 1 apply to the Work of each specification section.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. The Owner has a critical need for the Work to begin upon Notice to Proceed and shall be Substantially Complete by **May 5, 2028.** There will be **No** Extensions of Time due to weather.

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include:
   1. Lump sum allowances.
   2. Contingency allowances.

1.3 COORDINATION

A. Coordinate allowance items with other portions of the Work.

1.4 LUMP SUM ALLOWANCES

A. Allowances shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

   1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.5 CONTINGENCY ALLOWANCES

A. Use of contingency is not allowed except as defined in the General Conditions. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation**,** taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's markups as defined in the General Conditions.

D. At Project closeout or as further defined in the General Conditions, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

A. Owner's Contingency Allowance: $900,000.00
   1. Refer to General Conditions for additional information.

B. Super Graphics Allowance: $250,000.00
   1. Contractor shall include the amount indicated above in his Base Proposal for the cost of purchasing, delivering, and installing the Super Graphics on the Project.

C. Wet Weather Site Conditions Allowance $ (TBD By Contractor)
   1. The Contractor shall provide an allowance for the removal of wet, weak soil and replace with select fill, properly compacted should the on-site soils become wet and weak, and unable to support construction equipment after or during a rainy season or rain events. Payment for removal or replacement of wet / weak soils shall be based upon the "removal of unsatisfactory soil material" Unit Price on 01 22 00 UNIT PRICES specifications. Refer to the Wet Weather / Soft Subgrade Considerations (Constructability) notes on S-013 – GENERAL SUBGRADE NOTES AND TYPE DETAILS for more information.

D. Concrete Allowance $16,150.00
   1. Provide an allowance for an additional 85 cubic yards of concrete. Size of members and use of members shall be directed by the architect in the field. Allowance shall include / account for all costs for material, fabrication, delivery, labor for installation / placement, formwork, etc. Reinforcement of concrete shall also be included as part of this allowance and shall be assumed to be 2% minimum by volume. Any unused portion of the 85 cubic yards shall be credited back to the owner at $190.00 / cubic yard. Refer to S-011 Allowance Notes.

E. Miscellaneous Steel Allowance $38,400.00
   1. Provide an allowance for an additional 8 tons of miscellaneous steel. Sizes of members and use of members shall be as directed by the architect in the field. Allowance shall include / account fr all costs for materials, fabrication, delivery, erection, etc. Any unused portion of the 8 tons of steel shall be credited back to the owner at $4,800.00 per ton. Refer to S-011 Allowance Notes.

END OF SECTION 01 21 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include:
   1. Lump sum allowances.
   2. Unit cost allowances.
   3. Quantity allowances.
   4. Contingency allowances.
   5. Testing and inspecting allowances.

1.3 COORDINATION

A. Coordinate allowance items with other portions of the Work.

1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight**,** and delivery to site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

   1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.5 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation**,** taxes, insurance, equipment rental, and similar costs.

C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
   4. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
   1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
   2. No change to Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

A. Wet Weather Site Conditions Allowance: (TBD by Contractor)

1. The contractor shall provide an allowance for the removal of wet, weak soil and replace with select fill, properly compacted should the on-site soils become wet and weak, and unable to support construction equipment after or during a rainy season or rain events. Payment for removal and replacement of wet / weak soils shall be based upon the 'Removal of unsatisfactory soil and replacement with satisfactory soil material' unit price in "01 22 00 – UNIT PRICES" specifications. Refer to the "Wet Weather / Soft Subgrade Considerations (Constructability)" notes on "S-013 – GENERAL SUBGRADE NOTES AND TYP DETAILS" for more information.

B. Concrete Allowance: ($16,150)

1. Provide an allowance for an additional 85 cubic yards of concrete. Size of members and use of members shall be as directed by the architect in the field. Allowance shall include/account for all costs for material, fabrication, delivery, labor for installation/ placement, formwork, etc. Reinforcement for concrete shall also be included as part of this allowance and shall be assumed to be 2% minimum by volume. Any unused portion of the 85 cubic yards shall be credited back to the owner at $190.00 / cubic yard. Refer to S-011 Allowance Notes.

C. Miscellaneous Steel Allowance: $38,400

1. Provide an allowance for an additional 8 tons of miscellaneous steel. Sizes of members and use of members shall be as directed by the architect in the field. Allowance shall include/account for all costs for material, fabrication, delivery, erection, etc. Any unused portion of the 8 tons of steel shall be credited back to the owner at $4,800.00 / ton. Refer to S-011 Allowance Notes.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:
1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
1. Description: Unsatisfactory soil excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."
2. Unit of Measurement: Cubic yard of soil excavated, based on survey of volume removed. Cost shall include all materials, labor, overhead and profit for complete installation satisfactory soil material.

3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

B. Unit Price No. 2: Rock excavation and replacement with satisfactory soil material.
1. Description: Classified rock excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."
2. Unit of Measurement: Cubic yard of rock excavated, based on survey of volume removed. Cost shall include all materials, labor, overhead and profit for complete installation of satisfactory soil material.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

C. Unit Price No. 3: Cutting and patching of concrete floor slabs.
1. Description: Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents.
2. Unit of Measurement: Square feet of concrete removed. Cost shall include all materials, labor, overhead and profit for complete installation of concrete floor slab.

D. Unit Price No. 4: Cement Stabilized Sand and Lean Concrete
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for the complete installation of cement stabilized sand and lean concrete. Enter unit cost on Proposal form.

E. Unit Price No. 5: Select Fill
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation of select fill. Enter unit cost on Proposal Form.

F. Unit Price No. 6: Flowable Fill
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of flowable fill or controlled low-strength material (CLSM), delivered, spread, and compacted per plans and specs. Cost shall include all materials, labor, overhead and profit for complete installation. Enter unit cost on Proposal Form.

G. Unit Price No. 7: Concrete
1. Description: This unit price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new concrete material, delivery, labor for installation/ placement, formwork, etc per plans and specs. Reinforcement for concrete shall also be included and shall be assumed to be 2% minimum by volume. Enter unit cost on Proposal Form.

H. Unit Price No. 8: Grade Beam (Add)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam. Enter unit cost for each grade beam size on Proposal Form.

I. Unit Price No. 9: Grade Beam (Deduct)
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials, labor, detailing, overhead and profit for complete installation of grade beam. Enter unit cost for each grade beam size on Proposal Form.

J. Unit Price No. 10: Drilled Pier (Add)
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) drilled pier of each drilled pier size utilized in the project per the Pier Schedule in S-300 series. Cost shall include all materials, labor, detailing, overhead and profit for complete installation. Enter unit cost for each drilled pier size on Proposal Form.

K. Unit Price No. 11: Drilled Pier (Deduct)
   1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) drilled pier of each drilled pier size utilized in the project per the pier schedule in the S-300 series. Cost shall include all materials, labor, detailing, overhead and profit for complete installation. Enter unit cost for each drilled pier size on Proposal Form.

L. Unit Price No. 12: Pier Casings
   1. Description: The contractor shall provide a unit price for each size of casing for all pier types utilized on the project.
   2. Unit of Measurement: Net length of casing utilized multiplied by the unit price. Cost shall include all materials, labor, overhead and profit for complete installation.

M. Unit Price No. 13: Miscellaneous and structural steel
   1. Description: Miscellaneous lintels and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications." This unit price shall be the entire unit cost including overhead and profit for one (1) pound of fabricated steel as indicated on the itemized invoice of steel supplier and verified by the Architect. Cost shall include all materials, labor, detailing, engineering, erection, overhead and profit for complete installation. Enter unit cost on the Proposal Form.

N. Unit Price No. 15: Existing Pier Demo Condition 1 (Overlap With New Pier)
   1. Description: At any location where a new pier will overlap an existing footing/pier, the soil currently in the existing footing/pier shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size

O. Unit Price No. 16: Existing Pier Demo Condition 2 (No Conflict with New Piers)
   1. Description: At any location where an existing footing/pier does not overlap with a new pier, the portion of the existing footing/pier within 4.5 ft of the bottom of the future slab shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698). The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure

that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including materials, labor, special testing & inspections, overhead and profit for all the work described in the GC Note on the foundation demo plans for each pier size.

END OF SECTION 01 22 00

SECTION 01 22 00 – UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for unit prices.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to the individual Specification Sections for Work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this Work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 – PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. See Exhibit S in CSP Documents Pg. 53-63
B.

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes: Administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain Work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described are part of the Work when enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent Work as necessary to completely integrate Work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Forty-eight (48) hours following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other Work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. See Exhibit S is the CSP Pg. 46-53

END OF SECTION 01 23 00

SECTION 01 23 00 - ALTERNATES

Refer to RPF-CSP #1006-26; XXXI. EXHIBIT S – BID ALTERNATES AND UNIT PRICING FORM FOR WRITTEN ADD / DEDUCT FOR EACH ALTERNATE.

3.1 ALTERNATES

A. Alternate Number 1a: 23 64 27 – Rotary-Screw Water Chillers Air-Cooled – **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Rotary-Screw Water Chillers Air-Cooled manufactured by **Carrier** as shown and scheduled on the drawings and as specified. The alternate chiller price shall include (5) five-year full parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) there are no chillers included in the base bid.

B. Alternate Number 1b: 23 64 27 – Rotary-Screw Water Chillers Air-Cooled – **Trane**

2. Contractor to furnish Rotary-Screw Water Chillers Air-Cooled manufactured by **Trane** as shown and scheduled on the drawings and as specified. The alternate chiller price shall include (5) five-year full parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) there are no chillers included in the base bid.

C. Alternate Number 1c: 23 64 27 – Rotary-Screw Water Chillers Air-Cooled – **JCI / York**

3. Contractor to furnish Rotary-Screw Water Chillers Air-Cooled manufactured by **JCI / York** as shown and scheduled on the drawings and as specified. The alternate chiller price shall include (5) five-year full parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) there are no chillers included in the base bid.

D. Alternate Number 2a: 23 73 13.19 – Custom Indoor Central-Station Air Handling Units manufactured by **Carrier 39CC Custom**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Custom Indoor Central-Station Air Handling Units, manufactured by **Carrier; model 39CC Custom** as shown and scheduled on the drawings and as specified; there are no Custom Indoor Central-Station Air Handling Units included in the base bid.

E. Alternate Number 2b: 23 73 13.19 – Custom Indoor Central-Station Air Handling Units manufactured by **ClimateCraft – Provided by Hunton Trane**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Custom Indoor Central-Station Air Handling Units, manufactured by **ClimateCraft** as shown and scheduled on the drawings and as specified; there are no Custom Indoor Central-Station Air Handling Units included in the base bid.

F. Alternate Number 2c: 23 73 13.19 – Custom Indoor Central-Station Air Handling Units manufactured **by JCI / York Custom**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Custom Indoor Central-Station Air Handling Units, manufactured by **JCI / York; Custom** model as shown and scheduled on the drawings and as specified; there are no Custom Indoor Central-Station Air Handling Units included in the base bid.

G. Alternate Number 3a: 23 74 13 – Packaged, Outdoor, Central-Station Air Handling Units manufactured by **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Air Handling Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified. The alternate price shall include the five (5) year full parts, labor, refrigerant, etc. extended warranty (re: 1.7 Warranty); there are no Packaged, Outdoor, Central -Station Air Handling Units included in the base bid.

H. Alternate Number 3b: 23 74 13 – Packaged, Outdoor, Central-Station Air Handling Units manufactured by **Trane / Valent**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Air Handling Units, manufactured by **Trane / Valent** as shown and scheduled on the drawings and as specified. The alternate price shall include the five (5) year full parts, labor, refrigerant, etc. extended warranty (re: 1.7 Warranty); there are no Packaged, Outdoor, Central -Station Air Handling Units included in the base bid.

I. Alternate Number 3c: 23 74 13 – Packaged, Outdoor, Central-Station Air Handling Units manufactured by **JCI / York**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Air Handling Units, manufactured by **JCI / York** as shown and scheduled on the drawings and as specified. The alternate price shall include the five (5) year full parts, labor, refrigerant, etc. extended warranty (re: 1.7 Warranty); there are no Packaged, Outdoor, Central -Station Air Handling Units included in the base bid.

J. Alternate Number 4a: 23 09 23 – Direct Digital Controls – **Automated Logic Corporation**

1. This Alternate shall establish the amount to adjust the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Automated Logic Corporation; WEBCTRL® – Installed by **Automated Logic Corporation (ALC) – Houston**. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information.

K. Alternate Number 4b: 23 09 23 – Direct Digital Controls – **Unify Energy Solutions**

2. This Alternate shall establish the amount to adjust the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Reliable Controls – Installed by **Unify Energy Solutions**. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information.

L. Alternate Number 5a: 23 52 16 – Condensing Boilers manufactured by **Hydrotherm** and 21 51 00 Breechings, Chimneys and Stacks all **provided by GOES Heating**.

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Hydrotherm – KN Series** and Breechings, Chimney's and Stacks **provided by GOES Heating** as shown and scheduled on the drawings and as specified. Alternate boiler price shall include warranty as specified per 1.9.

M. Alternate Number 5b: 23 52 16 – Condensing Boilers manufactured by **Camus - Avenger Model** and 21 51 00 Breechings, Chimneys and Stacks **all provided by Delta T Equipment**.

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Camus** as shown and scheduled on the drawings and as specified; there are no Boilers included in the base bid. The alternate boiler price shall include extended parts and labor warranty per 1.9 Warranty.

N. Alternate Number 6a: 23 82 19.13 – Fan Coil Units: manufactured by **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

O. Alternate Number 6b: 23 82 19.13 – Fan Coil Units: manufactured by **Trane**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Trane** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

P. Alternate Number 6c: 23 82 19.13 – Fan Coil Units: manufactured by **JCI / York**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **JCI / York** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

Q. Alternate Number 7a: 23 81 26 – Ductless Mini-Split-System Air-Conditioners: Manufactured by **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Ductless Mini-Split-System Air-Conditioners manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Ductless Mini-Split-System Air-Conditioners included in the base bid.

R. Alternate Number 7b: 23 81 26 – Ductless Mini-Split-System Air-Conditioners: Manufactured by **Mitsubishi provided by Hunton Trane**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Ductless Mini-Split-System Air-Conditioners manufactured by **Mitsubishi** as shown and scheduled on the drawings and as specified; there are no Ductless Mini-Split-System Air-Conditioners included in the base bid.

S. Alternate Number 8a: 23 05 14 – Variable Frequency Drives: Manufactured by **ABB**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Variable Frequency Drives manufactured by **ABB** as shown and scheduled on the drawings and as specified; there are no Variable Frequency Drives included in the base bid.

T. Alternate Number 8b: 23 05 14 – Variable Frequency Drives: Manufactured by **Danfoss**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Variable Frequency Drives manufactured by **Danfoss** as

shown and scheduled on the drawings and as specified; there are no Variable Frequency Drives included in the base bid.

U. Alternate Number 8c: 23 05 14 – Variable Frequency Drives: Manufactured by **Toshiba**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Variable Frequency Drives manufactured by **Toshiba** as shown and scheduled on the drawings and as specified; there are no Variable Frequency Drives included in the base bid.

V. Alternate Number 9a: 23 21 23 – Hydronic Pumps: Manufactured by **Bell & Gossett**

4. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction Diffusers, manufactured by **Bell & Gossett** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

W. Alternate Number 9b: 23 21 23 – Hydronic Pumps: Manufactured by **Pentair / Aurora**

5. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction diffusers, manufactured by **Pentair / Aurora** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

X. Alternate Number 9c: 23 21 23 – Hydronic Pumps: Manufactured by **Armstrong**

6. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction Diffusers, manufactured by **Armstrong** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

Y. Alternate Number 9d: 23 21 23 – Hydronic Pumps: Manufactured by **Taco**

7. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction Diffusers, manufactured by **Taco** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

Z. Alternate Number 10: 26 50 00 – Light Fixture Package

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish light fixtures as shown and scheduled on the drawings and as specified. The alternate will be broken down with 2 options which correlate to the light fixture schedule shown on the proposal documents. This alternate pricing shall include any batteries, drivers, generator transfer devices, fixture accessories, exit signs, parking poles/heads, wall packs, decorative supports or mountings as well as any wiring required to connect light fixture to remote battery or driver. Alternate pricing shall also include any attic stock of fixtures or drivers listed in the project. This alternate pricing shall not include the sports field lighting.

   a. Alternate No. 10A: Light Fixture Package from **CW Lighting**.
   b. Alternate No. 10B: Light Fixture Package from **Lesco.**
   c. Alternate No. 10C: Light Fixture Package from **PSA.**

AA. Alternate Number 11: 26 09 43 – Digital Lighting Controls

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish a non-networked digital lighting control system as detailed

on the drawings and as specified. The alternate will be broken down with 2 options which correlate to the acceptable products associated with this project. This alternate pricing shall include any wall switches, power packs, occupancy sensors, daylight harvesting sensors, handheld devices, relays, wiring and any accessories associated with a complete lighting control system. Alternate pricing shall also include any attic stock listed in the project.

a. Alternate 11A: Digital Lighting Control solution from **Dynalite.**
b. Alternate 11B: Digital Lighting Control solution from **Acuity.**
c. Alternate 11C: Digital Lighting Control solution from **Cooper Lighting Solutions.**

BB. Alternate Number 12a: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **Hellas**

8. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **Hellas** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

CC. Alternate Number 12b: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **Astroturf**

9. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **Astroturf** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

DD. Alternate Number 12c: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **FieldTurf**

10. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **FieldTurf** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

EE. Alternate Number 12d: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **Paragon**

11. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **FieldTurf** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

FF. Alternate Number 13: Provide optional adjustment to the Base Proposal.

END OF SECTION

SECTION 01 23 00 - ALTERNATES

Refer to RPF-CSP #1006-26; XXXI. EXHIBIT S – BID ALTERNATES AND UNIT PRICING FORM FOR WRITTEN ADD / DEDUCT FOR EACH ALTERNATE.

3.1 ALTERNATES

A. Alternate Number 1a: 23 64 27 – Rotary-Screw Water Chillers Air-Cooled – **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Rotary-Screw Water Chillers Air-Cooled manufactured by **Carrier** as shown and scheduled on the drawings and as specified. The alternate chiller price shall include (5) five-year full parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) there are no chillers included in the base bid.

B. Alternate Number 1b: 23 64 27 – Rotary-Screw Water Chillers Air-Cooled – **Trane**

2. Contractor to furnish Rotary-Screw Water Chillers Air-Cooled manufactured by **Trane** as shown and scheduled on the drawings and as specified. The alternate chiller price shall include (5) five-year full parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) there are no chillers included in the base bid.

C. Alternate Number 1c: 23 64 27 – Rotary-Screw Water Chillers Air-Cooled – **JCI / York**

3. Contractor to furnish Rotary-Screw Water Chillers Air-Cooled manufactured by **JCI / York** as shown and scheduled on the drawings and as specified. The alternate chiller price shall include (5) five-year full parts, labor, refrigerant, etc. extended warranty (re: 1.10 Warranty) there are no chillers included in the base bid.

D. Alternate Number 2a: 23 73 13.19 – Custom Indoor Central-Station Air Handling Units manufactured by **Carrier 39CC Custom**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Custom Indoor Central-Station Air Handling Units, manufactured by **Carrier; model 39CC Custom** as shown and scheduled on the drawings and as specified; there are no Custom Indoor Central-Station Air Handling Units included in the base bid.

E. Alternate Number 2b: 23 73 13.19 – Custom Indoor Central-Station Air Handling Units manufactured by **ClimateCraft – Provided by Hunton Trane**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Custom Indoor Central-Station Air Handling Units, manufactured by **ClimateCraft** as shown and scheduled on the drawings and as specified; there are no Custom Indoor Central-Station Air Handling Units included in the base bid.

F. Alternate Number 2c: 23 73 13.19 – Custom Indoor Central-Station Air Handling Units manufactured **by JCI / York Custom**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Custom Indoor Central-Station Air Handling Units, manufactured by **JCI / York; Custom** model as shown and scheduled on the drawings and as specified; there are no Custom Indoor Central-Station Air Handling Units included in the base bid.

G. Alternate Number 3a: 23 74 13 – Packaged, Outdoor, Central-Station Air Handling Units manufactured by **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Air Handling Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified. The alternate price shall include the five (5) year full parts, labor, refrigerant, etc. extended warranty (re: 1.7 Warranty); there are no Packaged, Outdoor, Central -Station Air Handling Units included in the base bid.

H. Alternate Number 3b: 23 74 13 – Packaged, Outdoor, Central-Station Air Handling Units manufactured by **Trane / Valent**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Air Handling Units, manufactured by **Trane / Valent** as shown and scheduled on the drawings and as specified. The alternate price shall include the five (5) year full parts, labor, refrigerant, etc. extended warranty (re: 1.7 Warranty); there are no Packaged, Outdoor, Central -Station Air Handling Units included in the base bid.

I. Alternate Number 3c: 23 74 13 – Packaged, Outdoor, Central-Station Air Handling Units manufactured by **JCI / York**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Packaged, Outdoor, Central-Station Air Handling Units, manufactured by **JCI / York** as shown and scheduled on the drawings and as specified. The alternate price shall include the five (5) year full parts, labor, refrigerant, etc. extended warranty (re: 1.7 Warranty); there are no Packaged, Outdoor, Central -Station Air Handling Units included in the base bid.

J. Alternate Number 4a: 23 09 23 – Direct Digital Controls – **Automated Logic Corporation**

1. This Alternate shall establish the amount to adjust the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Automated Logic Corporation; WEBCTRL® – Installed by **Automated Logic Corporation (ALC) – Houston**. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information.

K. Alternate Number 4b: 23 09 23 – Direct Digital Controls – **Unify Energy Solutions**

2. This Alternate shall establish the amount to adjust the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Reliable Controls – Installed by **Unify Energy Solutions**. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information.

L. Alternate Number 5a: 23 52 16 – Condensing Boilers manufactured by **Hydrotherm** and 21 51 00 Breechings, Chimneys and Stacks all **provided by GOES Heating**.

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Hydrotherm – KN Series** and Breechings, Chimney's and Stacks **provided by GOES Heating** as shown and scheduled on the drawings and as specified. Alternate boiler price shall include warranty as specified per 1.9.

M. Alternate Number 5b: 23 52 16 – Condensing Boilers manufactured by **Camus - Avenger Model** and 21 51 00 Breechings, Chimneys and Stacks **all provided by Delta T Equipment**.

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Condensing Boilers, manufactured by **Camus** as shown and scheduled on the drawings and as specified; there are no Boilers included in the base bid. The alternate boiler price shall include extended parts and labor warranty per 1.9 Warranty.

N. Alternate Number 6a: 23 82 19.13 – Fan Coil Units: manufactured by **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

O. Alternate Number 6b: 23 82 19.13 – Fan Coil Units: manufactured by **Trane**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Trane** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

P. Alternate Number 6c: 23 82 19.13 – Fan Coil Units: manufactured by **JCI / York**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **JCI / York** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

Q. Alternate Number 7a: 23 81 26 – Ductless Mini-Split-System Air-Conditioners: Manufactured by **Carrier**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Ductless Mini-Split-System Air-Conditioners manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Ductless Mini-Split-System Air-Conditioners included in the base bid.

R. Alternate Number 7b: 23 81 26 – Ductless Mini-Split-System Air-Conditioners: Manufactured by **Mitsubishi provided by Hunton Trane**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Ductless Mini-Split-System Air-Conditioners manufactured by **Mitsubishi** as shown and scheduled on the drawings and as specified; there are no Ductless Mini-Split-System Air-Conditioners included in the base bid.

S. Alternate Number 8a: 23 05 14 – Variable Frequency Drives: Manufactured by **ABB**

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Variable Frequency Drives manufactured by **ABB** as shown and scheduled on the drawings and as specified; there are no Variable Frequency Drives included in the base bid.

T. Alternate Number 8b: 23 05 14 – Variable Frequency Drives: Manufactured by **Danfoss**

2. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Variable Frequency Drives manufactured by **Danfoss** as

shown and scheduled on the drawings and as specified; there are no Variable Frequency Drives included in the base bid.

U. Alternate Number 8c: 23 05 14 – Variable Frequency Drives: Manufactured by **Toshiba**

3. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Variable Frequency Drives manufactured by **Toshiba** as shown and scheduled on the drawings and as specified; there are no Variable Frequency Drives included in the base bid.

V. Alternate Number 9a: 23 21 23 – Hydronic Pumps: Manufactured by **Bell & Gossett**

4. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction Diffusers, manufactured by **Bell & Gossett** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

W. Alternate Number 9b: 23 21 23 – Hydronic Pumps: Manufactured by **Pentair / Aurora**

5. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction diffusers, manufactured by **Pentair / Aurora** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

X. Alternate Number 9c: 23 21 23 – Hydronic Pumps: Manufactured by **Armstrong**

6. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction Diffusers, manufactured by **Armstrong** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

Y. Alternate Number 9d: 23 21 23 – Hydronic Pumps: Manufactured by **Taco**

7. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Hydronic Pumps and Pump Suction Diffusers, manufactured by **Taco** as shown and scheduled on the drawings and as specified; there are no Hydronic Pumps included in the base bid.

Z. Alternate Number 10: 26 50 00 – Light Fixture Package

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish light fixtures as shown and scheduled on the drawings and as specified. The alternate will be broken down with 2 options which correlate to the light fixture schedule shown on the proposal documents. This alternate pricing shall include any batteries, drivers, generator transfer devices, fixture accessories, exit signs, parking poles/heads, wall packs, decorative supports or mountings as well as any wiring required to connect light fixture to remote battery or driver. Alternate pricing shall also include any attic stock of fixtures or drivers listed in the project. This alternate pricing shall not include the sports field lighting.

   a. Alternate No. 10A: Light Fixture Package from **CW Lighting**.
   b. Alternate No. 10B: Light Fixture Package from **Lesco.**
   c. Alternate No. 10C: Light Fixture Package from **PSA.**

AA. Alternate Number 11: 26 09 43 – Digital Lighting Controls

1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish a non-networked digital lighting control system as detailed

on the drawings and as specified. The alternate will be broken down with 2 options which correlate to the acceptable products associated with this project. This alternate pricing shall include any wall switches, power packs, occupancy sensors, daylight harvesting sensors, handheld devices, relays, wiring and any accessories associated with a complete lighting control system. Alternate pricing shall also include any attic stock listed in the project.

a. Alternate 11A: Digital Lighting Control solution from **Dynalite.**
b. Alternate 11B: Digital Lighting Control solution from **Acuity.**
c. Alternate 11C: Digital Lighting Control solution from **Cooper Lighting Solutions.**

BB. Alternate Number 12a: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **Hellas**

8. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **Hellas** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

CC. Alternate Number 12b: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **Astroturf**

9. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **Astroturf** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

DD. Alternate Number 12c: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **FieldTurf**

10. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **FieldTurf** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

EE. Alternate Number 12d: 32 18 23.30 – Infilled Monofilament Synthetic Turf System by **Paragon**

11. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Infilled Monofilament Synthetic Turf for the filed turf as manufactured by **FieldTurf** as specified and shown on the drawings. Do no include Infilled Monofilament Synthetic Turf System for field turf in the base proposal.

FF. Alternate Number 13: Provide optional adjustment to the Base Proposal.

END OF SECTION

SECTION 01 25 13 - PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Specified product compliance, and product quality assurance.

B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.

C. Requirements for product delivery, storage and handling.

1.3 RELATED REQUIREMENTS

A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.4 DESCRIPTION OF REQUIREMENTS

A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as “specialties”, “systems”, “structure”, “finishes”, “accessories”, “furnishings”, “special construction”, and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.
   1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor’s previously purchased stock. The term “product” as used herein includes the terms “material”, “equipment”, “system”, and other terms of similar intent.
      a. Named Products: Are those identified by the use of the manufacturer’s name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
      b. Specified Products: same as Named Products.
   2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
   3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.5 PRODUCT QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
   1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer’s determination has been made, select products from those

sources that produce products that possess the most important qualities, to the fullest extent possible.

B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.

C. Or Equal:
1. Where the phrase “or equal”, “or equivalent”, “or Architects approved equal”, or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
2. The decision of the Architect shall be final.

D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.

E. Foreign Product Limitations: “Foreign products” as distinguished from “domestic products” are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
    a. There is no domestic product available that complies with the requirements of the Contract Documents.
    b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
    c. At the discretion of the Architect or Owner.

2. Final determination and acceptance will be the responsibility of the Architect.

F. Standards: Refer to Section 01 41 00, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.6 SUBSTITUTIONS OF PRODUCTS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts,

performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.

D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final

E. The following are not considered as substitutions:
   1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as “changes” not substitutions.
   2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
   3. Except as otherwise provided in the Contract Documents, the Contractor’s determination of and compliance with governing authorities do not constitute “substitutions” and do not constitute a basis for change orders.

F. The following may be considered as a reason for a request for substitution:
   1. The request is directly related to an “or approved equal” clause or similar language in the Contract Documents.
   2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
   3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
   4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
   5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
   6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
   7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

G. Availability of specified items:
   1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
   2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
   3. The request will not be considered if the product or method cannot be provided as a result of the Contractor’s failure to pursue the work promptly or coordinate activities properly.
   4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

H. A request constitutes a representation that Offeror:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

I. **No substitutions will be considered after the Award of Contract.**

1.7 SUBSTITUTION REQUEST SUBMITTAL

A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
2. Samples, where applicable or requested.
3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
6. Cost information, including a proposal of the net change, if any in the Contract Sum.
7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.

B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage

times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.

1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.
2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
   1. Proprietary.
   2. Descriptive.
   3. Performance.
   4. Compliance with Reference Standards.

B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process

C. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
   1. Proprietary and Semi-Proprietary Specification Requirements:
      a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
      b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
   2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict

the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.

3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.
4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "…as selected from the manufacturer's standard colors, patterns, textures…" or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.

D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.

B. Anchor each product securely in place, accurately located and aligned with other work.

C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

A. Coordinate all approved substitutions with adjacent work.

B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.

C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION 01 25 13

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.

B. Related Work:
1. Section 01 25 13 – Product Substitution Procedures.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 *Architect's Supplemental Instructions*.

1.4 PROPOSAL REQUESTS

A. Owner Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Work Change Proposal Requests issued by Architect are not instructions either to stop Work in progress or to execute the proposed change.
2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    a. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,

and activity relationship. Use available total float before requesting an extension of the Contract Time.

6. Comply with requirements in Section 01 25 00 if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use AIA Document G709.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: When an allowance is specified, refer to Section 01 21 00 for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   a. Include installation costs in purchase amount only where indicated as part of the allowance.
   b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
   d. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.

2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. Owner will reject claims submitted later than 7 days after authorization.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work and designates the method to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

B. Pencil Copy: A preliminary review copy of the application for payment for review by Architect and Owner prior to submission of final copy.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Coordinate line items in the schedule of values with administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Updated Submittal schedule.
      c. Items required to be indicated as separate activities in updated Contractor's construction schedule.

   2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment. Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.

   2. Arrange schedule of values consistent with format of AIA Document G703.

   3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.
      d. Name of manufacturer or fabricator.
      e. Name of supplier.
      f. Change Orders (numbers) that affect value.

g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
   1) Labor.
   2) Materials.
   3) Equipment rentals.
   4) General Conditions.
      a. Supervisor.
      b. Submittals.
      c. Close-out.
      d. Field Engineering.
      e. Daily Clean-up.
      f. Final Clean-up.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on site and items stored off site. Include evidence of insurance.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Submit preliminary (pencil) copy of proposed values to Architect or Architects field representative and Owner for review by 20th date of the month. Allow 48 hours for comments.

B. Once preliminary (pencil) approved, submit electronic copy of notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.

C. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

D. Submit updated construction or recovery schedule with each Application for Payment.

E. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document 00 73 00, Supplementary Conditions of the Contract.

F. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse.

G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
   1. Current Record Documents as specified in Section 01 77 00, Closeout Procedures

maintained.
2. Labor time sheets, purchase orders, or similar documentation.
3. Affidavits attesting to off-site stored products.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 29 00

SECTION 01 29 73 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.

B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.3 QUALITY ASSURANCE

A. Use required means to assure arithmetical accuracy of the sums described.

B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.4 SUBMITTALS

A. Prior to the first Application for Payment, submit a proposed schedule of values to the Owner, as outlined below:
   1. Meet with the Owner and determine additional data, if any, required to be submitted.
   2. Secure the Owner's approval of the schedule of values prior to submitting first Application for Payment.

1.5 SCHEDULE OF VALUES

A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.

B. Schedule of Values - Items in addition to Specification Sections.
   1. Mobilization
   2. Clean Up
   3. Building Permit
   4. Bonds, Insurance
   5. Misc. Mechanical Accessories
   6. Demolition
   7. Rough-In Labor - (Electrical)
   8. Rough-In Material - (Electrical)
   9. Finish Labor - (Electrical)
   10. Finish Material - (Electrical)
   11. Allowances (listed separately)
   12. Record drawings and close-out documents
   13. Submittals listed separately per mechanical, electrical and plumbing
   14. Roof warranty as a line item

15. Donated items individually itemized at $0.00 (zero dollars).

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

A. Refer to following sample.

END OF SECTION 01 29 73

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Pre-install meetings.

B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.

C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI's) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate Contractors if coordination of the Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.
   9. Coordinating inspections and other jurisdictional requirements.
   10. Coordinate OFCI equipment.
   11. Action items and issue logs.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
      b. Coordinate the addition of trade specific information to the coordination drawings by multiple Contractors in sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, ductwork, piping, and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
   a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
   b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
   c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
   a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
   c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
   d. Location of pull boxes and junction boxes, dimensioned from column center lines.
   e. Floor boxes.

8. Fire Protection System: Show the following:
   a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.

9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio

10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared

in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
   2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
   3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      b. Digital Data Software Program: Drawings are available in Revit.
      c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
   4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
   5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.

B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
   1. Conduct the conference to review responsibilities and personnel assignments.
   2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Agenda: Discuss items of significance that affect progress.
   4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
   5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

C. Preinstallation Conferences: Conduct a preinstallation trade conference at site before each construction activity that requires coordination with other construction trades.
   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of Record of scheduled meeting dates.
   2. Agenda: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.

3. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
    b. Six (6) week look-ahead schedules.
5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these

meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
   c. Review present and future needs of each Contractor present.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting. Refer to General Conditions - usage of the Owner’s construction project management software is required.
4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 31 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect’s action.

B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

C. Portable Document Format (PDF): An open standard file format used for representing documents in a device independent and display resolution independent fixed layout document format.

1.4 SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
   1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
      a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
      b. Digital Drawing Software Program: The Contract Drawings are available in Revit.
      c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.

d. The following digital data files will by furnished for each appropriate discipline:
   1) Floor plans.
   2) Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
   3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
   5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow ten (10) days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
   2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
   3. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to Owner**,** containing the following information:
      a. Project name.
      b. Date.
      c. Name and address of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Name of firm or entity that prepared submittal.
      g. Names of subcontractor, manufacturer, and supplier.
      h. Category and type of submittal.
      i. Submittal purpose and description.
      j. Specification Section number and title.
      k. Specification paragraph number or drawing designation and generic name for each of multiple items.

l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

4. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submit electronic submittals via email as PDF electronic files.
      a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
         OR
   2. Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

   3. Certificates and Certifications Submittals: Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
      a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in PDF electronic file.

C. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.

3. Submit Shop Drawings in PDF electronic file.
4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
   a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
   b. Refer to Section 01 31 00 for requirements for coordination drawings.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Key Items Review Time: Submit samples to the Architect at least 30 days prior to the date the Contractor needs the reviewed submittals returned. The Contractor shall be prepared to submit color samples on any key items in Division 09 finishes within 30 days of the award of Contract. Once samples of all key items are received, the Architect will finalize color selections.
   b. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.
   5. Submit product schedule in PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Division 01.

G. Contractor's Construction Schedule: Comply with requirements specified in Division 01.

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00.

J. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00.

K. Maintenance Data: Comply with requirements specified in Section 01 78 23.

L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.
   5. Description of product.
   6. Test procedures and results.
   7. Limitations of use.

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed

before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
   1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
   4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   1. Laboratory Mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
   2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
   3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality Control Testing: Tests and inspections performed on site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations.
   1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, *experienced* means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting Work on the following systems:
   1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
   2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.

I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.

c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow **seven** days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8’x8’. Mockup shall include all major façade elements and at least one window minimum 2’x2’ in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

N. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
   2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
   3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
   5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300.

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:

B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00.

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 40 00

SECTION 01 45 23 – STRUCTURAL TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, ASTM specifications and the Contract Documents.

B. The testing laboratory shall provide as a part of the project's close-out documents or as required by any regulatory authority, all appropriate signed and sealed Special Inspection Certificates whose purpose would be to provide consistency and direction for compliance with the referenced Building Code. These Special Inspection Certificates shall confirm that that all work requiring special inspection has been adequately performed, and the special inspections have been made by an individual or firm that is qualified to make special inspections per the referenced Building Code.

C. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.

D. Testing, inspection, and certifications specified in other sections of these Specifications shall be paid by the Owner, unless otherwise indicated.

E. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

1.3 REFERENCED STANDARDS

A. The latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise.

B. ACI 311 – ACI Manual of Concrete Inspection

C. ACI 301 - Specification for Structural Concrete

D. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY ASSURANCE

A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.

B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than $500,000.

C. Testing Laboratory shall be under the direction of a Registered Engineer who is legally authorized to practice in the jurisdiction where Project is located and having at least five years experience in inspection and testing of construction materials.

D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.

E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.

F. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES

A. Attend preconstruction meetings and progress meetings as required to coordinate work with the Contractor and address quality control issues.

B. Test samples of design mixes submitted by Contractor.

C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.

D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.

E. Ascertain compliance of materials and mixes with requirements of Contract Documents.

F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non conformance of Work or Materials.

G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.

H. Testing Laboratory shall write a letter at the completion of the project, signed, and sealed by a registered engineer in the state of the project, summarizing the inspections performed, the dates they were performed, and whether the observed construction complied with the Contract Documents.

1.6 LABORATORY REPORTS

A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.

B. Include:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and specifications section
6. Location in the Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.

B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

A. See technical sections of these specifications for specific requirements.

B. Deliver to the laboratory, without cost to the Owner, adequate samples of materials proposed for use which are required to be tested.

C. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.

D. Provide facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM specifications C31.

E. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.

F. Furnish concrete mix designs, in accordance with ACI 301, section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs are required, the laboratory shall be selected and paid by the Contractor.

G. Provide current welder certifications for each welder to be employed.

H. Furnish fabrication and erection inspection of all welds in accordance with AWS D1.1, Chapter 6.

I. Prequalification of all welding procedures to be used in executing the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PIER DRILLING

A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.

B. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.

C. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not casing is required, bell size (if required), actual penetration into bearing stratum, and elevation of top of bearing stratum.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.

B. Observe and report on the following:

1. Number and size of bars
2. Bending and lengths of bars
3. Splicing
4. Clearance to forms including chair heights
5. Clearance between bars or spacing
6. Rust, form oil, and other contamination
7. Grade of Steel
8. Securing, tying and chairing of bars
9. Excessive congestion of reinforcing steel
10. Installation of anchor bolts and placement of concrete around anchor bolts
11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents

C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.3 REINFORCING STEEL MECHANICAL SPLICES

A. Each mechanical splice shall be visually inspected to ensure compliance with the ICBO Reports and the manufacturer's published criteria for acceptable completed splices.

B. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the ICBO report.

C. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and whether splice is accepted or rejected. Reasons for rejection shall be shown on each report.

3.4 CONCRETE INSPECTION AND TESTING

A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.

B. Mold and cure specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.

C. Test specimens in accordance with ASTM C39. Two specimens shall be tested 7 days, two specimens shall be tested at 28 days for strength acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28-day break does not meet strength requirements. If the plans require 56-day break (such as for mass concrete), two samples shall be tested at 56 days for acceptance.

D. Make one strength test (four or five cylinders) for each:

1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
2. OR, for each 5000 sq. ft. of slab area placed in one day.
3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Architect/Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.

E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.

F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.

G. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.

H. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.

I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Architect, the Contractor, and the Concrete Supplier.

J. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications and shall be rejected.

K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.

L. Laboratory reports shall contain the following information:

1. Class of concrete and specific location.
2. Specified strength of concrete.
3. Air temperature.
4. Batch time.
5. Specified time that discharge of concrete must be completed, based on air temperature.
6. Time concrete is placed.
7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
8. Amount of water added at the site.
9. Allowable slump range on the approved mix design.
10. Slump.
11. Maximum and minimum allowable concrete temperature on the approved mix design.
12. Temperature of the concrete mix.
13. Air content range on the approved mix design.
14. Air content.
15. Statement that concrete is in compliance with the project documents and the approved mix designs.

M. Evaluation and Acceptance:

1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.

N. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

O. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).

P. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

3.5 MASONRY

A. Inspection

1. Provide a qualified inspector to inspect all structural masonry work.
   a. Inspect masonry for compliance in accordance with the “Level 1 or 2 Special Inspection” provisions of the building code. Refer to the contract documents regarding which level of special inspections is required.
2. In combination with inspections required by the building code, inspect the following:
   a. Preparation of masonry prisms for testing.
   b. Placement of reinforcing.
   c. Cavities to be grouted (prior to grouting and prior to closing cleanouts).
   d. Mortar mixing operations, including proportion of materials and method of measuring materials (materials should be measured with a mixing box and not a shovel).
   e. Bedding of mortar for each type of unit and placing of units.
   f. Grouting operations.
   g. Condition of units before laying for excessive absorption.
3. Provide report of each inspection.

B. Field Compressive Tests for Grout:

1. Secure composite samples of grout at the jobsite in accordance with ASTM C 1019.
2. Mold and cure three specimens from each sample in accordance with ASTM C 1019. Supervise the curing protection provided (by others) for test specimens in the field and the transportation from the field to the laboratory. The test specimens shall be stored in the field 24 to 48 hours and then be carefully transported to the laboratory and cured in accordance with ASTM C 1019.
3. Test specimens in accordance with ASTM C 1019. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at 7 days for information.
4. Make one strength test (three specimens) for each 10 cubic yards of grout poured but not less than one strength test for each 5000 square feet of wall area.

C. Prism Tests:

1. Build prisms at the jobsite using the same materials and methods as being used for the wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as masonry construction. After 48 hours, move prisms to the laboratory and test in accordance with ASTM C1314.
2. Make prism tests in advance of operations using materials under same conditions, with the same bonding and construction methods as is being used for the structure. When building

prisms, moisture content of the units at time of laying, consistency of mortar and width and thickness of mortar joints shall be same as used in the structure.

3. Build prisms of hollow masonry units the same width as unit by 16" long by 16" high. Apply mortar to face shells only. Do not fill hollow core with grout. Compute value of ultimate net compressive strength, by dividing ultimate load by net face shell area of masonry units.
4. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to the jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5000 square feet of wall placed.
5. The prisms shall be tested after 28 days but may be tested at seven days provided the relationship between seven and 28 day strengths has been established for the materials used prior to the start of construction.
6. When the average strength of a set of prisms falls below the specified compressive strength (f'm), the masonry corresponding to the test shall be deemed unacceptable. In such a case, notify the Architect and Contractor immediately.

3.6 STRUCTURAL STEEL

A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.

B. Field Inspection

1. Proper erection of all pieces.
2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
3. Plumbness of structure and proper bracing.
4. Field Painting.
5. Visual examination of all field welding.
6. Ultrasonic testing of all penetration welds.
7. Installation of field welded shear studs.
8. Measure and record camber of all beams upon arrival and before erection for compliance with the specified camber. Measure lying flat with web in horizontal position. Members outside specified camber tolerance shall be returned to the shop for remedial work.

C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify all welder's qualifications.

D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:

1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
2. Ultrasonically test all penetration welds in accordance with AWS D1.1.

3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.
4. The welding inspector shall be present during alignment and fit-up of members being welded and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
5. The inspector shall check that all welds have been marked with the welder's symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.
7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.

E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:

1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.
2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration and shall confirm that the procedure to be used provides the required tension.
4. For slip critical connections, inspect the contact surfaces for compliance with specifications prior to bolting.

F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1 and as follows:

1. A minimum of two shear studs shall be welded at the start of each day's production period in order to determine proper generator, control unit and stud welding setting. These studs shall be capable of being bent at 45 degrees from vertical without weld failure.
2. When the temperature is below 32 degrees Fahrenheit, one stud in each 100 shall be tested after cooling. Studs shall not be welded below zero degrees Fahrenheit or when the surface is wet due to rain, snow, or ice. If a stud fails, two new studs shall pass the test before resumption of the welding.
3. Visually inspect studs for compliance with the Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

3.7 OPEN WEB JOISTS AND JOIST GIRDERS

A. Inspect all joists either in the plant or at the jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices, and straightness of members. Inspection at the plant may be performed by the manufacturer's qualified QC personnel.

B. Inspect installation of joists at the jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with the Contract Documents and referenced standards.

C. Check welder qualification certificates for field welding operators.

3.8 STEEL FLOOR DECK

A. Field Inspection shall consist of the following:

1. Check types, gauges, and finishes for conformance with the Contract Documents and shop drawings.
2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
3. Certification of welders.
4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the structural steel section of this specification section.

3.9 STEEL ROOF DECK

A. Field inspection shall consist of the following:

1. Checking types, gauges, and finishes for conformance with the Contract Documents and Shop Drawings.
2. Examination for proper erection of all metal deck, including fastenings at supports and sidelaps, reinforcing of holes, and miscellaneous deck supports.
3. Certification of welders.
4. Visual inspection of at least 20 percent of all welds.

3.10 SPRAYED FIREPROOFING

A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.

B. Verify that installation meets fire rating requirements of approved design.

C. Inspect and test for thickness as follows:

1. Test 20 percent of structural frame columns and beams in each building level.

2. Test 10 percent of beams other than structural frame in each building level.
3. Test one slab per each 5000 square feet of building area.

D. Inspect and test for density on slabs, beams, and columns. Perform one of each test for each 10,000 square feet of building area.

E. Inspect and test for bond strength, one test for beams and one test for slabs for each 10,000 square feet or area.

F. Inspection and test procedures shall be performed in accordance with ASTM E605 and E736.

3.11 EXPANSION BOLT INSTALLATION

A. Inspect the drilling of each hole and installation of each expansion bolt for compliance with the Contract Documents.

B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.12 TESTING OF NON-SHRINK GROUT

A. Make one strength test for every 15 base plates grouted and for every 15 bags of grout used in joints between members.

B. Each test shall consist of four cubes, two to be tested at seven days, and two at 28 days, made and tested in accordance with ASTM C109, with the exception that the grout shall be restrained from expansion by a top plate.

3.13 EXCAVATION

A. A representative of the Owner’s Geotechnical Engineer shall provide the services specified in this section.

B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.

C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.

D. Review required submittals as they pertain to geotechnical requirements.

E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.

F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

3.14 WATER PRESSURE INJECTION OR LIME SLURRY PRESSURE INJECTION

A. The representative of the Owner's Geotechnical Engineer shall make continuous observations throughout the injection operations as per the geotechnical report.

B. The representative of the Owner's Geotechnical Engineer may propose to perform additional tests if required to properly evaluate the injected soil. The representative of the Owner's Geotechnical Engineer shall evaluate the results of the tests to determine the acceptability of the injected areas and to determine if additional injections are required.

3.15 FILLING AND BACKFILLING

A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.

B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.

C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:

1. Test for liquid limit in accordance with ASTM D423.
2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.

D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.

E. Inspect under slab drainage material and placement for compliance with specified gradation, quality, and compaction.

F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:

1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

3.16 TILT-UP PANELS

A. Concrete Reinforcing Steel and Embedded Metal Assemblies: Inspect in accordance with the Concrete Reinforcing Steel and Embedded Metal Assemblies section of this Specification.

B. Concrete Inspection and Testing: Perform in accordance with the Concrete and Inspection and Testing section of this specification.

C. Inspection of Tilt-up concrete during erection:

1. Inspect members for cracks, spalls, and other deficiencies after erection.
2. Inspect erection of tilt-up members for placement tolerances, and to ensure that connections, bearing lengths, welding and grouting conform to the Contract Documents.

3.17 POST-TENSIONING

A. Verify certification of calibration of jacking equipment used in post-tensioning operations.

B. Observe and report on placement and anchorage of tendons immediately prior to concreting.

C. Provide a qualified, experienced inspector to observe the stressing and elongation measurement of each tendon. Inspector shall have a minimum of five years' experience inspecting post-tensioning operations.

D. The Contractor shall log and submit detailed reports of the stressing and elongation of each tendon. The laboratory representative shall observe the recording of information by the Contractor and make such spot checks as necessary to verify the accuracy of the post tensioning reports.

E. Receive and review final stressing and elongation reports prepared by the contractor. Compare the actual and required elongation of each tendon and the actual and required load on each tendon. Grant permission to cut tails of tendons which are within the specified tolerance, unless otherwise noted on the Drawings, and submit reports of those which are not within the specified tolerance to the Architect for further evaluation.

F. Observe and report on grouting of tendons noted to be bonded.

G. Reports shall be submitted to the Architect within 48 hours after stressing.

H. The post-tensioning subcontractor shall provide a letter at the completion of the project, signed and sealed by a registered engineer in the state of the project, stating that the post-tensioning work was completed in accordance with the contract documents. The post-tensioning subcontractor shall review the stressing records and certify that the required forces shown on the contract documents have been provided.

3.18 FOOTING EXCAVATIONS

A. A representative of the Owner's Geotechnical Engineer shall inspect each footing excavation to determine that the proper bearing stratum is obtained and that excavations are properly clean and dry before the concrete is placed.

END OF SECTION 01 45 23

SECTION 01 45 23 - TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements and qualifications including but not limited to:
   1. Professional testing and laboratory services.
   2. Accessories necessary for the completion of testing and laboratory services.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
   4. Specific test and inspection requirements are not specified in this Section.

C. A qualified independent testing laboratory and/or geotechnical engineering service selected and paid by Owner.
   1. The Owner will pay for the initial laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents.

D. Inspecting agency shall perform inspections and tests in accordance with the rules and regulations of the building code, local authorities, Specifications of ASTM, and the Contract Documents.

E. Materials and workmanship found not in compliance with required standards or performance obligations shall be removed and replaced. Replacement and subsequent testing shall be at Contractor’s expense.

F. Where terms “Inspector” and “Laboratory” are used, it is meant and in reference to an officially designated and accredited inspector of the testing laboratory or geotechnical service engaged by Owner.

G. Laboratory inspections shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

H. Contractor or Fabricator shall cooperate with the testing laboratory in matters pertaining to the Work.

I. Contractor to address deficiency and failed reports.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329 and ASTM E534; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
   3. Testing agencies shall be insured against errors and omissions by a professional liability insurance policy having a minimum limit of liability of $500,000.00.

B. Inspection and testing services the of testing agency shall be under the direction of a Registered Engineer licensed in the State of Texas, charged with engineering managerial responsibility, and having a minimum of five (5) years engineering experience in inspection and testing of construction materials.

C. Concrete Inspectors: Inspecting personnel monitoring concrete Work shall be ACI certified inspectors.

D. Structural Steel: Primary inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, *Standard and Guide for Qualification and Certification of Welding Inspectors*.
   1. Inspector may be supported by assistant inspectors who perform specific inspection functions under the direct supervision of the Primary Inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant inspectors shall be monitored daily by the inspector.

E. Testing Equipment: Equipment shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards.

F. Referenced Standards: Latest adopted edition of standards referenced apply to the Work. In the event of conflict between the Contract Documents and referenced standards, the Contract Documents shall govern. In case of conflict between Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY CONTROL

A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
   1. Refer to the individual specification sections for specific requirements.
   2. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.

3. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
4. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
5. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
8. Associated Responsibilities and Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
    a. Provide access to the Work.
    b. Deliver of samples to testing laboratory, without cost to Owner, in adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
    c. Advise laboratory and Architect sufficiently in advance of construction operations to allow laboratory to complete required inspections or tests and to assign personnel for field inspection and testing as specified.
    d. Provide facilities for storage and curing of concrete test samples on site for the first 24 hours and for subsequent field curing required by ASTM C31.
    e. Incidental labor, facilities, and equipment necessary to assist laboratory personnel in obtaining and handling samples at the site.
    f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
    g. Provide concrete mix designs in accordance with ACI 301 Section 3.9 made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, select and pay for laboratory.
    h. Obtain required inspections or approvals of the building official. Inspection requests and notifications required by building code are responsibility of the Contractor.
    i. Provide current welder certificates for each welder employed.
    j. Provide fabrication and erection inspection and testing of welds in accordance with AWS D1.1, Chapter 6.
        1) Use prequalification of welding procedures in executing the Work.

    k. Security and protection for samples and for testing and inspecting equipment at Project site.

9. Retesting/Reinspecting: Regardless of payment responsibility of the original tests or inspections, provide quality control services, including retesting and reinspecting, for construction that replaced Work failing to comply with the Contract Documents or Code requirements.

C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

D. Coordination: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.5 AUTHORITY AND DUTIES OF LABORATORY PERSONNEL

A. A representative of the testing laboratory, who has reviewed and is familiar with the project and specifications, shall participate in preconstruction conferences. The representative shall coordinate material testing and inspection requirements with the Contractor and its subcontractors consistent with the planned construction schedule. The laboratory representative shall attend conferences required or requested to address quality control issues.

B. Laboratory personnel shall inspect and test materials, assemblies, specimens, and Work performed, including design mixes, methods and techniques and report the progress to the Architect.

C. If material or Work fails to meet requirements of Contract Documents, laboratory inspector shall notify the Construction Manager, Architect, Engineers, supplier or subcontractor providing or preparing the materials or Work being tested of such failure.

D. Laboratory personnel shall not perform the Work of the Contractor or act as foremen or superintendents. Work will be inspected as it progresses, but failure to detect defective Work or materials shall not prevent later rejection when a defect is discovered.

E. Laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release the requirements of the Contract Documents or approve or accept portions of Work, except where approval is specifically specified in the Specifications.

F. Comply with building code requirements for Special Inspections.

1.6 SUBMITTALS

A. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality control service.

C. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

D. Submit copies of reports of each inspection and test:
   1. Owner, Program or Project Manager, Architect, and each Engineer or outside consultants regarding their particular phase of the project: One copy each.
   2. Construction Manager and Contractor: Two copies each.

E. In addition to furnishing a written report, notify Construction Manager and Contractor verbally of uncorrected conditions or failures to comply with requirements of the Contract Documents, and immediately fax and email corresponding report to the Architect and Engineer.

F. At completion of each trade or branch of Work requiring inspecting and testing, submit a final certificate attesting to satisfactory completion of Work and full compliance with requirements of Contract Documents.

G. Submit copies of test results sealed by a Registered Engineer to municipal authorities having jurisdiction, as required.

1.7 TESTING LABORATORY GUIDELINES AND PROCEDURES

A. Technicians scheduled to perform specific testing services must be qualified to review and perform other services that overlap, i.e. earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the site.

B. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for hours over eight hours spent at the site on a single day, field testing services performed on a Saturday or Sunday, and field services performed on a recognized holiday.

C. There shall be a three hour minimum for each scheduled testing service. Vehicle charges will be included on a $25.00 per trip basis.

D. Cylinder pick up will be controlled by the technician performing test on a scheduled pick up day. If there are no testing services scheduled, the cylinder pick up fee is $40.00 on week days and $50.00 on weekends and holidays with no technician or vehicle charge.

E. The Contractor shall bear the responsibility of scheduling the testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the testing services. Cancellations or failed test shall be reimbursable to the Owner by the responsible party for the cancellations or failure of a test or service.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.
   5. Deficiency log.

B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 TESTING AND INSPECTION SERVICES

A. Testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.

B. The Owner reserves the right to add to or delete any or all inspection and testing specified, excluding testing required by the applicable building codes.

C. If conflicts arise between Drawings and Specifications, notify Architect immediately. The most stringent requirements shall dictate procedure.

3.3 TESTING OF EARTHWORK

A. Testing Services (As specified or required):
   1. References (As applicable for tests required):
      a. American Society for Testing and Materials (ASTM):
         1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3).
         2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth).
         3) D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

      b. American Association of State Highway and Transportation Officials (AASHTO)
         1) T89, Determining the Liquid Limit of Soils.
         2) T90, Determining the Plastic Limit and Plasticity Index of Soils.
         3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305-mm (12-in) Drop.
         4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth).

   2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab on grade, and backfills.
   3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
   4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.

5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material,
6. Perform one in place density test for each 4,000 square feet (445 square yards) of existing subgrade material.
7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one test for each 4,000 square feet (445 square yards) of each lift of compacted fill.
9. Perform testing at a frequency of one in-place density and moisture test for each 75 lineal feet or less of utility trench, with a minimum of three tests per lift.

B. Reports: Submit reports with the following information:
1. Type and condition of soil at footing bottoms.
2. Level of water table in the excavated areas.
3. Grain size distribution of fill materials (average of three tests).
4. Moisture density test results.
5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
6. Notify Architect by telephone within one hour of the discovery of the following conditions and follow up telephone notification with written report.
   a. Materials used, or degree of soil compaction not meeting specified requirements.
   b. Frost and freeze protection requirements for excavation bottoms not being complied with.
   c. Water in excavations which is not being removed prior to Work being performed in excavation.

3.4 INSPECTION OF PIPED SITE UTILITIES

A. Laboratory representative shall observe and report on the following:
1. Proper alignment and grade of trenches.
2. Pipe bedding and supports.
3. Pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
4. Installation of pipe and joints.
5. Testing of piped utilities performed by Contractor.

3.5 PAVING

A. Testing Services: Perform field tests for moisture density properties:
1. Provide field testing of the subgrade as specified.
2. Paving Subbase: Provide one field test for every 7,500 square feet of area of crushed limestone or caliche subbase.
3. Lime Treated Subgrade: Provide one field test for every 7,500 square feet of area of lime treated subgrade for content of lime and subgrade compaction.
4. Cement Soil Stabilization: Provide one field test for every 7,500 square feet of area of cement stabilized subgrade for content of cement and subgrade compaction.

3.6 PIER DRILLING OPERATION

A. A representative of a qualified geotechnical laboratory shall provide services specified.

B. Laboratory representative shall make continuous inspections to determine that proper bearing stratum is obtained and utilized for bearing and that shafts are properly clean and dry before placing concrete.

C. Laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, casing required or not required, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.

D. Laboratory representative shall make continuous inspections of drilled pier construction to check the following:
1. Verify soundness of bearing stratum and desired penetration.
2. Verify pier dimensions and reinforcing used.
3. Monitor condition of hole and removal of water and loose material from bottom.
4. Monitor placement of concrete and use of tremie or pumps.
5. Monitor the extraction of casing, if used.

E. Request probe holes when deemed necessary to confirm safe bearing capacity.

3.7 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspect concrete reinforcing steel prior to placing concrete for compliance with Contract Documents and approved shop drawings. Noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and, if left uncorrected, reported to the Architect.

B. Laboratory representative shall observe and report on the following:
1. Number and size of bars.
2. Bending and lengths of bars.
3. Splicing.
4. Clearance to forms, including chair heights.
5. Clearance to sides and bottom of trench if soil formed.
6. Clearance between bars or spacing.
7. Rust, form oil, and other contamination.
8. Grade of steel.
9. Securing, tying, and chairing of bars.
10. Excessive congestion of reinforcing steel.
11. Installation of anchor bolts and placement of concrete around such bolts.
12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.

C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years' experience inspecting reinforcing steel in projects of similar size.

3.8 CONCRETE INSPECTION AND TESTING

A. Receive and evaluate proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, the laboratory shall submit a letter to the Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by the laboratory as being unacceptable. Check the proposed mixes for proportions, water cement ratio and slump in accordance with ACI 613 and 318.

B. Comply with ACI 311 *Guide For Concrete Inspection* and ACI *Manual of Concrete Inspection* (SP-2).

C. Sample and test concrete placed at the site in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis.

D. Test concrete:
   1. Mold and cure five specimens from each sample.
      a. For each 50 cubic yards or fraction thereof of structural building concrete; and
      b. For each 100 cubic yards or fraction thereof of nonstructural concrete and site Work paving and sidewalks.
      c. Laboratory cure two cylinders in accordance with ASTM C192.
      d. Field cure remaining cylinders in accordance with ASTM C31.

   2. Two specimens shall be tested at seven days for information, two shall be tested at 28 days for acceptance.

E. Deviations from the requirements of ASTM Specifications shall be recorded in the test report. Test concrete specimens in accordance with ASTM C39.

F. Specimens for pumped concrete shall be taken at the discharge end of pumping equipment.

G. Supervise curing and protection provided for test specimens in field, and transportation from the field to laboratory. Test cylinders shall be stored in the field 24 hours and then carefully transported to laboratory and cured in accordance with ASTM C31.

H. Make one strength test (four cylinders) of each mix design of concrete placed in any one day.

I. Make one slump test for each set of cylinders following procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever consistency of concrete appears to vary. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.

J. Determine total air content of air entrained normal weight concrete sample for each strength test in accordance with ASTM C231.

K. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.

L. Determine temperature of concrete sample for each strength test.

M. Inspect each batch of concrete, monitor addition of mixing water to assure uniform consistency from truck to truck. Check mixing form mixers before mix begins to set and within time limits set forth in ASTM C94.
   1. Monitor addition of water and high range water reducer to concrete at job site and length of time concrete is allowed to remain in truck during placement.

N. Testing agency shall furnish and maintain a competent inspector at the mixing plant at the start of each day's mixing. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content of each batch, general operation of the plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in fine and course aggregate has been properly accounted for in the concrete mixing to achieve required consistency and water cement ratio.

O. Testing laboratory shall monitor addition of water to concrete at the jobsite and the length of time concrete is allowed to remain in the truck before placement. Inspector shall compare

mixture with criteria on the approved mix design and report any significant deviation to the Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on the approved mix design.

P. Observe placing of concrete, except nonstructural slabs on grade and site Work. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

Q. Test reports shall include but no be limited to the following information: date of concrete placement, concrete mix identification number or proportion of ingredients, truck ticket number, time test was made, time of batching, location of each placement, slump, unit weight, water content (microwave test) and air content of concrete sampled and date and results of strength test.

R. Report promptly to Architect all details of reasons for rejection of any and all quantities of concrete. Give all information concerning locations of the concrete pours, quantities, date of pours, and other pertinent facts concerning concrete represented by the specimens.

S. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and time at which cement and aggregate were dispensed into the truck, and time at which concrete was discharged from the truck.

T. Evaluation and Acceptance:
1. If measured slump, or air content of air entrained concrete, falls outside specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, concrete shall be considered to have failed to meet the requirements of the specifications, and shall not be used in the structure.
2. Strength level of concrete will be considered satisfactory if the averages of sets of three consecutive strength tests results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
3. Completed concrete Work will be accepted when requirements of ACI 301 Chapter 18 *Specifications for Structural Concrete for Buildings* have been met.

U. Concrete Test Reports: Reports shall be made and distributed immediately after respective tests or inspections are made.
1. Where reports indicate deviations from Contract Documents, they shall also include a determination of the probable cause of deviation and where applicable, a recommendation for corrective action.

V. Furnish a statistical analysis for each class of concrete placed on the project in accordance with ACI 214 and ACI 318. Information shall be updated and distributed once a month as directed by the Architect. Information shall include, but not be limited to, the following:
1. Strength tests at 7 days of one cylinder.
2. Strength tests at 28 days of two cylinder averages.
3. 28 day moving average strength tests of last three test groups.
4. Standard deviation and coefficient of variation based on 28 day strength tests.
5. Average strength and number of 28 days tests for most recent month.

W. Test Footings (Shafts) (Piers) (Caissons): Same diameter and type specified for footings, placed in same manner. Accepted test footings may be used in the Work.

X. Noncompliant Test Reports: Fax test reports indicating noncompliance immediately to each party on the test report distribution list. Copies shall be on different colored paper.

Y. Inspect application of curing compound and monitor curing conditions to assure compliance with specification requirements. Report curing deficiencies to the Contractor immediately and submit a written report to the Architect.

3.9 TESTING OF NONSHRINK GROUT

A. Make one strength test for all plates grouted and for all grout used in joints between members.

B. Each test shall consist of four cubes, two tested at 7 days and two at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.10 STRUCTURAL STEEL

A. Inspect structural steel during and after erection for compliance with Contract Documents and shop drawings. Review and report on fabricator's quality control procedures and capabilities.

B. Field Inspection:
1. Proper erection of pieces.
2. Proper touch up painting of shop primed structural steel exposed to view or in crawl space.
3. Proper installation of bolts.
4. Plumbness of structure and proper bracing.
5. Proper field painting.
6. Initial inspection of welding process and periodically thereafter as necessary.
7. Visual examination of completed welds.
8. Ultrasonic testing of penetration field welds.
9. Installation of field welded shear studs.
10. Inspect shop fabricated members, upon arrival at the site, for defects incurred during transit and handling.
11. Measure and record camber of beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Return members outside specified camber tolerance to shop for correction.

C. Qualifications of Welders: Fabricator and erector shall provide the testing laboratory with names of welders employed on Work, along with certification that each welder has passed qualification tests within the past 12 months, using procedures covered in AWS D1.1 *Structural Welding Code - Steel*. Verify welder qualifications.

D. Inspection of field welding shall include:
1. Visually inspect fillet welds for size, soundness, and proper return around ends. Inspect seams, folds, and delaminations.
2. Visually inspect welds for proper repair of painting.
3. Ultrasonically test penetration welds in accordance with ASTM E164.
4. Inspect surfaces to be welded. Note surface preparations, fit up, and cleanliness of surface. Verify electrodes for size, type, and condition.
5. Welding inspector shall be present during alignment and fit up of members being welded, and shall verify for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, inspector shall order the joint to be chipped down to sound metal, or gouged out, and rewelded. Thoroughly inspect root passes for cracks. Gouge out cracks and rewelded to 2 inches beyond each end of crack.
6. Inspector shall verify that welds have been marked with welder's symbol and shall mark welds requiring repairs and reinspection. Inspector shall maintain a written record of welds. Work completed and inspected shall receive an identification mark by the

inspector. Identify unacceptable material and Work identified by word *reject* or *repair* marked directly on the material.

7. Testing agency shall advise the Owner and Architect of any shop and/or field conditions which may require further tests and examination by means other than those specified. Additional tests and examinations shall be performed as authorized by the Owner and Architect.
8. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
9. Weld quality to comply with the American Institute of Steel Construction (AISC) Manual of Steel Construction.
10. Determine percentage of weld tested by the number of welds that fail the initial testing.
11. Reweld and retest welds that fail until the welds pass. Test two additional welds for every weld failure.

E. Inspect bolted construction in accordance with AISC *Specification for Structural Steel Buildings*:
1. Visually inspect bolts ensuring that plies have been brought into snug contact.
2. Inspect high strength bolt in accordance with Section 9 of the *Specifications for Structural Joints Using ASTM A325 or A490 Bolts*.

F. Inspect stud welding in accordance with Section 7.8, of AWS D1.1 *Structural Welding Code*:
1. Weld at least two shear studs at the start of each production period to determine correct generator, control unit, and stud welder setting. The studs shall be capable of being bent 45 degrees from vertical without weld failure.
2. When the temperature is below 32 degrees F (0 degrees C), test one stud in each 100 after cooling. Do not weld studs at temperatures below 0 degrees F or when surface is wet with rain or snow. If stud fails in the weld, two new studs shall pass the test before resumption of welding.
3. Visually inspect studs for compliance with the requirements of the Contract Documents. Verify number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud, that stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from the missing weld. Studs failing test shall be replaced.

3.11 REINFORCING STEEL MECHANICAL SPLICES

A. Inspection and Observation Services:
1. Visually inspect and report on completed condition of each mechanical splice of reinforcing steel.
2. Visually inspect each mechanical splice to ensure compliance with the ICC-ES Reports and the manufacturer's published criteria for acceptable completed splices.
3. Place special emphasis on the inspection of the end preparation of each bar to be spliced required by the ICC-ES Report.

B. Reports: Submit reports to Architect:
1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Indicate reasons for rejection on each report.

3.12 OPEN WEB JOISTS AND JOIST GIRDERS

A. Inspect joists at jobsite for compliance with specified fabrication requirements. Verify welded connections between web and chord, splices, and straightness of members.

B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for compliance with Contract Documents and referenced standards.

C. Verify welder qualification certificates for both shop and field welding operators.

3.13 METAL FLOOR DECK

A. Field inspection shall consist of:
1. Verifying types, gauges and finishes for compliance with Contract Documents and shop drawings.
2. Examine composite floor deck exposed to crawl space for damage to galvanizing due to welding or construction activities. Repair galvanized composite floor deck in accordance with the specifications.
3. Examine the erection of metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
4. Certification of welders.
5. Inspect and test field welded shear studs used to fasten metal floor decking to supporting steel as specified for structural steel.

3.14 METAL ROOF DECK

A. Field inspection shall consist of:
1. Verify types, gauges and finishes for compliance with Contract Documents and shop drawings.
2. Examine the erection of the metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
3. Certification of welders.
4. Visual inspection of at least 25 percent of welds.

3.15 SPRAYED FIREPROOFING

A. Verify applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.

B. Verify installation complies with fire rating requirements of approved design.

C. Inspect and test for thickness:
1. Test 25 percent of structural frame columns and beams in each building level.
2. Test 10 percent of beams other than structural frame in each building level.
3. Test one slab per 5,000 square feet of building area.

D. Inspect and test in accordance procedures of ASTM E605 and ASTM E736.

3.16 EXPANSION BOLT INSTALLATION

A. Inspect drilling of each hole and installation of each expansion bolt for compliance with Contract Documents and shop drawings.

B. Verify installation torque for each expansion bolt for compliance with manufacturer’s installation instructions.

3.17 LIGHTWEIGHT INSULATING CONCRETE FILL

A. Inspection and Observation Services (As required):
1. Inspection of roof deck prior to start of Work.

2. Inspection during installation of insulation and lightweight insulating concrete fill Work to ascertain compliance with Contract Documents.
3. Observation of base ply fastener pull tests performed by Contractor to ascertain minimum withdrawal resistance of 40 pounds per fastener.

B. Testing Services (As required):

1. References (As applicable for tests required):
   a. American Society for Testing and Materials (ASTM)
      1) C177 - Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded Hot Plate Apparatus.
      2) C495 - Test Method for Compressive Strength of Lightweight Insulating Concrete.
      3) C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
   a. Mix design compressive strength.
   b. Mix design wet and dry density range.
   c. Number of Tests:
      1) One per 5,000 square feet.
      2) Not less than one for each day's Work.

4. Test EPS insulation board for density in accordance with ASTM C578.

3.18 TESTING OF ROOFING

A. Inspection and Observation Services (As required):
1. Inspection of roof deck prior to start of Work.
2. Inspect on site condition of stored roofing materials.
3. Inspection during roofing, roof insulation, and sheet metal Work to ascertain compliance with Contract Documents.
4. Observation of roof test cuts performed by Contractor to ascertain that they are properly made.
5. Observation of patching of roof test cuts to ascertain that they are properly made.

B. Testing Services (As required):
1. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.

3.19 MASONRY

A. Inspection and Observation Services:
1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
2. Review mortar design mixes.
3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.

B. Testing Services:

1. References (As applicable for tests required):
   a. ASTM International (ASTM)

1) C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
2) C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
3) C1019 - Standard Test Method for Sampling and Testing Grout.

2. Testing of Concrete Masonry Units (CMU):
   a. Preconstruction: Perform the following tests in accordance with ASTM C140.
      1) Compressive Strength
      2) Absorption
      3) Weight
      4) Moisture Content
      5) Dimensions.

3. Mortar Tests:
   a. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
   b. 28 Day Compressive Strength
   c. Water Retention
   d. Construction: Perform 28 day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one test per 2,000 square feet of masonry.

4. Refer to and include Work for reinforcing steel specified.
5. Grout Tests:
   a. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
      1) 28 Day Compressive Strength
      2) Construction: Perform 28 day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
      3) Prism Test: Perform preconstruction 28 day compressive strength test on concrete masonry walls in accordance with ASTM E447-97, Method B.

3.20 REPAIR AND PROTECTION

A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 29.

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 01 45 23

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
1. Water service and distribution.
2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
3. Heating and cooling facilities.
4. Ventilation.
5. Electric power service.
6. Lighting.
7. Telephone service.
8. Waste disposal facilities.
9. Field office.
10. Storage and fabrication sheds.
11. Lifts and hoists.
12. Construction aids and miscellaneous services and facilities.
13. Environmental protection.
14. Pest control.
15. Enclosure fence.
16. Security enclosure and lockup.
17. Barricades, warning signs, and lights.
18. Temporary partitions.
19. Fire protection.
20. Accessories necessary for a complete installation.

1.3 USE CHARGES

A. Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.

C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Moisture Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged work.
3. Indicate sequencing of Work that requires water, such as sprayed fire resistive materials, plastering, and tile grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

C. Dust and HVAC Control Plan: Submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. HVAC system isolation schematic drawing.
2. Location of proposed air-filtration system discharge.
3. Waste handling procedures.
4. Other dust control measures.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines (ADAAG), ICC/ANSI A117.1, and Texas Accessibility Standards (TAS) 2012.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. Chain Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E 84.

D. Dust Control Adhesive Surface Walk off Mats: Provide mats minimum 36 inches by 60 inches (914 mm by 1624 mm).

E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.

F. Lumber and Plywood: Comply with requirements in Section 06 10 53.

G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 29 00.

H. Paint: Comply with requirements in Section 09 90 00.

I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.

J. Water: Potable.

2.2 TEMPORARY FACILITIES

A. Contractor's Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.

B. Architect's Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Air Filtration Units: HEPA primary and secondary filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

C. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).

D. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

F. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control.
   1. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **8** at each return air grille in system and remove at end of construction. Clean HVAC system as required in Section 01 77 00 and install new filter with MERV 11 or greater.

G. Air Filtration Units: Primary and secondary HEPA filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate facilities where they will serve project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
1. Locate facilities to limit site disturbance as specified in Section 01 10 00.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. Install temporary service. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing Work, isolate the HVAC system in area where Work is to be performed according to coordination drawings.
a. Disconnect supply and return ductwork in Work area from HVAC systems servicing occupied areas.

b. Maintain negative air pressure within Work area using HEPA equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust producing equipment. Isolate limited Work within occupied areas using portable dust containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA filter equipped vacuum equipment.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated.
1. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
a. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
b. Provide warning signs at power outlets other than 110 to 120 V.
c. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
d. Provide metal conduit enclosures or boxes for wiring devices.
e. Provide 4 gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

J. Telephone Service: Provide temporary telephone service in common use facilities for use by construction personnel. Install one telephone line(s) for each field office.

1. Provide dedicated telephone line for each facsimile machine in each field office.
2. At each telephone, post a list of important telephone numbers.
a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

K. Electronic Communication Service: Provide a desktop computer and printer/scanner in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.
1. Provide high speed wireless internet access (provide access to the Owner and Architect); DSL or broadband. Dial-up connection is not acceptable.
2. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall.
3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
4. Backup: External hard drive, minimum 1 terabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00.
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent pavement until immediately before Substantial Completion.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Use: Use of elevators is not permitted.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
   2. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

G. Site Enclosure Fence: Before construction operations begin. Provide site enclosure fence to prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Partitions: Provide floor to ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas occupied from fumes and noise.
   1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire retardant treated plywood on construction operations side.
   2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces.
      a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.

   3. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
   4. Insulate partitions to control noise transmission to occupied areas.
   5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
   6. Protect air handling equipment.
   7. Provide walk off mats at each entrance through temporary partition.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
   1. Protect porous materials from water damage.
   2. Protect stored and installed material from flowing or standing water.
   3. Keep porous and organic materials from coming into prolonged contact with concrete.
   4. Remove standing water from decks.
   5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Periodically collect and remove waste containing cellulose or other organic matter.
   4. Discard or replace water-damaged material.
   5. Do not install material that is wet.
   6. Discard, replace, or clean stored or installed material that begins to grow mold.
   7. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Condition Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
   1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
   2. Use permanent HVAC system to control humidity.
   3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits and moisture control.
      a. Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.
      b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
      c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24 hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless otherwise required and approved by Owner and Architect.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00."

END OF SECTION 01 50 00

SECTION 01 57 13 - GENERAL SOURCE CONTROLS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes erosion and sedimentation control and other control related practices, which shall be utilized during construction activities.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 GENERAL

A. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

B. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated construction area. Damages caused by construction traffic or others to erosion and sedimentation control systems shall be repaired immediately by the Contractor.

C. The Contractor shall be responsible for collecting, storing, hauling, and disposing of spoils, silt, and waste materials as specified on the Drawings and in this or other Technical Specifications and in compliance with applicable federal, state, and local rules and regulations.

D. Contractor shall conduct all construction operation under this Contract in conformance with the erosion control practices described on the Drawings, the Storm Water Pollution Prevention Plan and this Section.

E. The Contractor shall install, maintain, and inspect erosion and sediment control measures and practices as specified on the Drawings and in this and other Technical Specifications.

F. Contractor shall employ protective measures to avoid damage to existing trees to be retained on the project site.

3.2 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENTATION CONTROL SYSTEMS

A. When topsoil is called for as a component of another Section, the Contractor shall conduct erosion control practices described in this Section during topsoil placement operation.

B. When placing topsoil, maintain erosion and sedimentation control systems.

C. Maintain grades, which have been previously established on areas to receive topsoil.

D. After the areas to receive topsoil have been brought to grade, and immediately prior to dumping

and spreading the topsoil, the subgrade shall be loosened by discing or by scarifying to a depth of at least two (2) inches to permit bonding of the topsoil to the subsoil.

E. No sod or seed shall be placed on soil, which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials.

3.3 DUST CONTROL

A. Dust control methods shall be implemented to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving stream or storm water conveyance system, to reduce on and offsite damage, to prevent health hazards, and to improve traffic safety.

B. Contractor shall control dust blowing by utilizing one or more of the following methods:
1. Mulches bound with chemical binders.
2. Temporary vegetative cover.
3. Spray-on adhesives on mineral soils when not used by traffic.
4. Tillage to roughen surface and bring clods to the surface.
5. Irrigation by water sprinkling.
6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.

C. Dust control methods shall be implemented immediately whenever dust can be observed blowing on the project site.

3.4 KEEPING STREETS CLEAN

A. Contractor shall keep the streets clean of construction debris, dirt, and mud generated by construction vehicles and equipment. If necessary, to keep the streets clean, Contractor shall provide stabilized construction exits at construction, staging, storage, and disposal areas. A vehicle/equipment wash area (stabilized with coarse aggregate) may be installed adjacent to the location of stabilized construction exit, as needed. Wash water shall be released into a drainage swale or inlet protected by erosion and sediment control measures.

B. In lieu of or in addition to stabilized construction exits, Contractor shall shovel and/or sweep the pavement to the extent necessary to keep the street clean. Water hosing or sweeping of debris and mud off the street into adjacent areas is not allowed.

3.5 EQUIPMENT MAINTENANCE AND REPAIR

A. Maintenance and repair of construction machinery and equipment shall be confined to areas specifically designated for that purpose. Such designated areas shall be located and designed so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed into receiving streams or storm water conveyance systems. These areas shall be provided with adequate waste disposal receptacles for liquid as well as solid waste. Maintenance areas shall be inspected and cleaned daily.

B. On the construction site where designated equipment maintenance areas are not feasible, care shall be taken during each individual repair or maintenance operation to prevent potential pollutants from becoming available to be washed into streams or conveyance systems. Temporary waste disposal receptacles shall be provided.

3.6 WASTE COLLECTION AND DISPOSAL

A. Contractor shall formulate and implement a plan for the collection and disposal of waste materials

on the construction site. The plan must designate locations for trash and waste receptacles and establish a collection schedule. Methods for ultimate disposal of waste shall be specified and carried out in accordance with applicable local, state, and federal health and safety regulations. Special provisions shall be made for the collection and disposal of liquid wastes and toxic or hazardous materials.

B. Receptacles and other waste collection areas shall be kept neat and orderly to the extent possible. Waste shall not be allowed to overflow its container or accumulate for excessively long periods of time. Trash collection points shall be located where they will least likely be affected by concentrated storm water runoff.

3.7 WASHING AREAS

A. Vehicles such as concrete or dump trucks and other construction equipment shall not be washed at locations where the runoff will flow into a watercourse or storm water conveyance system. Special areas shall be designated for washing vehicles. These areas should be located where the wash water will spread out and evaporate or infiltrate directly into the ground, or where the runoff can be collected in a temporary holding or seepage basin. Wash areas shall have gravel or rock bases to minimize mud generation. These areas shall be completely cleaned up, have waste remains hauled off, and be stabilized and seeded after the area is no longer required.

3.8 STORAGE OF CONSTRUCTION MATERIALS, CHEMICALS, ETC.

A. Sites where chemicals, cements, solvents, paints, or other potential water pollutants are to be stored, shall be isolated in areas where they will not cause runoff pollution.

B. Toxic chemicals and materials, such as pesticides, paints, and acids shall be stored in accordance with manufacturers' guidelines. Groundwater resources shall be protected from leaching by placing a plastic mat, packed clay or other impervious materials on any areas where toxic liquids are to be opened and stored.

3.9 DEMOLITION AREAS

A. Demolition work, which generates large amounts of dust, shall be provided with dust control techniques to limit the transport of the airborne pollutants. However, water or slurry used to control dust shall not be allowed to run directly into watercourses or storm water conveyance systems. Methods of ultimate disposal of these materials shall be carried out in accordance with applicable local, state and federal health and safety regulations.

3.10 SANITARY FACILITIES

A. The construction site must be provided with adequate sanitary facilities for workers in accordance with Division 1 and applicable health regulations.

3.11 PESTICIDES

A. The use of pesticides shall be approved by the Owner prior to application. A one-week notice will be required of the Contractor.

B. Pesticides used during construction shall be stored and used in accordance with manufacturers' guidelines and with local, state and federal regulations. Overuse of pesticides, which could generate contaminated runoff, shall be avoided and great care shall be taken to prevent accidental spillage. Pesticide containers shall never be washed in or near flowing streams or storm water conveyance systems.

3.12 PROTECTION OF TREES IN CONSTRUCTION AREAS

A. Heavy equipment, vehicular traffic, and stockpiles of construction materials, including topsoil, are not permitted within the dripline of any tree to be retained. Contractor shall avoid all contact with trees to be retained unless otherwise directed by the Owner or required by the work under this Contract.

B. Specimen trees shown on the Drawings shall be boxed or fenced. When called for in the Drawings, tunnel under the root system for the installation of utility lines.

C. Tree trunks, exposed roots, and limbs of the trees designated to be retained, which are damaged during construction operations, will be cared for as prescribed by a forester or licensed tree expert at the expense of the Contractor.

3.13 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13

SECTION 01 57 13.13 - FILTER FABRIC FENCE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes the installation of erosion and sedimentation control filter fabric fences (FFF) utilized during construction. The filter fabric fences are to be used to contain pollutants from overland flow. This practice shall not be used in channelized flow areas.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. American Society for Testing and Materials (ASTM).

C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.

D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabric.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of the disturbed soil. Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.
Representative Manufacturers: ADS Geosynthetics 8.0oz (0801T) or preapproved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and set out in this Section.

B. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

C. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.

D. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.

E. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.

F. Contractor shall employ protective measures described in Section 01 57 19 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

A. Provide filter fabric fence systems at locations shown on the Drawings in accordance with the Detail at the end of this Section or on the Drawings, entitled "Filter Fabric Fence". Filter fabric fence systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the filter fabric to 1-inch by 2-inch wooden stakes spaced a maximum of 3 feet apart and embedded in the ground a minimum of 1 foot. If factory preassembled fence with support netting is used, spacing of the post may be increased to 8 feet maximum. The wooden stakes shall be installed at a slight angle toward the source of anticipated runoff.

C. Trench in the toe of the filter fabric fence with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow or for V-trench configuration as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.

E. The filter fabric should be provided in continuous rolls and cut to the length of the Silt Fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap and sealed securely.

F. Inspect sediment filter fabric fence systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the fence in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END SECTION 01 57 13.13

SECTION 01 57 13.14 - REINFORCED FILTER FABRIC BARRIER

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes the installation of erosion and sedimentation control of reinforced filter fabric barriers (RFB) which must be utilized during construction. Reinforced filter fabric barrier is to be utilized to retain pollutants from passing downstream in channelized flow areas.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. The publications listed below forms a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM).

C. ASTM D-3786 - Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method.

D. ASTM D-4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

A. Manufacturer's catalogue sheets and other pertinent information on geotextile fabrics.

PART 2 - PRODUCTS

2.1 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 100 psi in any principal direction (ASTM D-4632), Mullen burst strength exceeding 200 psi (ASTM D-3786), and the equivalent opening size between 50 and 140, with the appropriate opening size to be selected based on the grain size characteristics of upstream disturbed soils. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F.
Representative Manufacturers: Mirafi, Inc. or preapproved equivalent.

B. Provide woven galvanized steel wire fence with minimum thickness of 14 gauge and a maximum mesh spacing of 6 inches.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide erosion and sedimentation control systems at the locations shown on the Drawings. Such systems shall be of the type indicated and shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section. No clearing and grubbing or rough cutting shall be permitted until erosion and sedimentation control systems are in place.

B. Regularly inspect and repair or replace components of all erosion and sedimentation control systems as specified for each type of system. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project area stabilization is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials as required by these Specifications.

C. Remove and dispose sediment deposits at the project designated spoil site. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local regulations.

D. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately. Contractor shall employ protective measures described in Section 01560 - General Source Controls to avoid damage to existing trees to be retained on the project site. Conduct all construction operations under this Contract in conformance with the erosion control practices described in that Section.

3.2 CONSTRUCTION METHODS

A. Provide reinforced filter fabric barrier systems at locations specified on the Drawings in accordance with the Detail, found at the end of this Section or on the Drawings, entitled "Reinforced Filter Fabric Barrier". Filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

B. Attach the woven wire support to steel fence posts (min. of 1.25 lbs. per linear foot & Brinell Hardness greater the 140) or 1-inch by 2-inch wooden stakes spaced a maximum of 6 feet apart and embedded a minimum of 8 inches. Steel post shall be made of hot rolled steel, at least 4 feet long with Tee or Y-bar sections with the surface painted or galvanized. Provide safety caps on top of metal posts. The posts shall be installed at a slight angle toward the source of the anticipated runoff.

C. Trench in the toe of the reinforced filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow as shown on the Detail. Lay filter fabric along the edges of the trench. Backfill and compact trench.

D. Reinforced filter fabric shall have a minimum height of 18 inches and a maximum height of 36 inches above the natural ground.

E. The filter fabric should be provided in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap and sealed securely.

F. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Section. Remove sediment deposits when silt reaches one-third of the height of the barrier in depth or 6 inches, whichever is less.

3.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13.14

SECTION 01 57 13.15 - STABILIZED CONSTRUCTION EXIT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This Section describes the installation of erosion and sedimentation control for stabilized construction exits utilized during construction and prior to the final development of the site.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCE STANDARDS

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM).

C. ASTM D 4632 - Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method).

1.4 SUBMITTALS

A. Manufacturer's catalog sheets and other pertinent information on geotextile fabric.

B. Sieve analysis of aggregates conforming to requirements of this Section.

PART 2 - PRODUCTS

2.1 SEPARATION GEOTEXTILE

A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632) and the equivalent opening size between 50 and 140, with the appropriate opening size to be approved in the review process based on the characteristics of the disturbed material. Both the geotextile and threads shall be resistant to chemical attack, mildew and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 degrees F to 120 degrees F. Representative Manufacturers: TenCrate Mirafi or preapproved equivalent.

2.2 COARSE AGGREGATES

A. Coarse aggregates shall consist of crushed stone, gravel, crushed blast furnace slag, or combinations thereof. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates shall conform to the following gradation requirements.

Sieve Size (Square Mesh)	Percent Retained (By Weight)
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

PART 3 - EXECUTION

3.1 GENERAL

A. To keep the street clean of mud generated by construction vehicles and equipment, Contractor shall provide stabilized construction exits at the construction site, staging, parking, storage, and/or disposal areas. Such erosion and sediment control system shall be constructed in accordance with the Detail - Stabilized Construction Exit attached hereto or shown on the Drawings, and any additional requirements shown on the Drawings and set out in this Section.

B. No clearing and grubbing or rough cutting, other than as specifically directed by the Owner to allow soil testing and surveying, shall be permitted until erosion and sedimentation control systems are in place.

C. Maintain existing erosion and sedimentation control systems located within the project site until acceptance of the project or until directed by the Owner to remove and discard the existing system.

D. Regularly inspect and repair or replace components of stabilized construction exists. Unless otherwise directed, maintain the erosion and sedimentation control systems until the project is accepted by the Owner. Remove erosion and sedimentation control systems promptly when directed by the Owner. Discard removed materials offsite.

E. Remove and dispose sediment deposits at the project designated spoil site. If a project spoil site is not designated on the Drawings, dispose of sediment offsite at location not in or adjacent to stream or floodplain. Off-site disposal will be the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state and local rules and regulations.

F. Equipment and vehicles of the Contractor, or on-site for his use, shall be prohibited from maneuvering on areas outside of the construction limits. Damages caused by construction traffic to erosion and sedimentation control systems shall be repaired immediately.

G. Conduct all construction operations under this Contract in conformance with the erosion control practices described in the Section 01 57 13 - General Source Controls.

3.2 CONSTRUCTION METHODS

A. Provide stabilized exits, entrances, access roads, parking areas, and other on-site vehicle transportation routes where shown on the Drawings.

B. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto area roadways. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas, which drain into a drainage system protected by erosion and sediment control measures.

C. Details for stabilized construction exit are shown on the Detail herein or as shown on the Drawings. Construction of other stabilized areas shall be to the same requirements. Roadway width shall be at least 30 feet and shall be sufficient for all ingress and egress to the site. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlaying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of fourteen days to minimize damage potential.

D. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering area roadways, receiving stream or storm water conveyance system.

E. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto area roadways shall be remove immediately.

F. The length of the stabilized area shall be as shown on the Detail or as shown on the Drawings, but not less than 50 feet in length. The thickness shall not be less than 8 inches. The width shall not be less than full width of all points of ingress or egress.

G. Stabilization for other areas shall have the same thickness, and width requirements as the stabilized construction exit, except where specified otherwise on the Drawings. The aggregate shall be a compacted limestone base material, 8 inches in thickness, with an application of emulsified asphalt. The emulsified asphalt material shall be reapplied periodically following any regrading of the limestone surface.

H. Stabilized area may be widened or lengthened to accommodate truck-washing area as required by the Contractor and approved by the Owner.

I. Alternative methods of construction, when preapproved by the Owner, may include the following.
   1. Cement Stabilized Soil - Compacted cement stabilized soil or other fill material in an application thickness of at least 8 inches.
   2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge to edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.
   3. Steel Mats - Perforated mats placed across perpendicular support members.

3.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this Section. Include all costs in the lump sum price, or in the unit price for Storm Water Pollution Prevention Plan.

END OF SECTION 01 57 13.15

SECTION 01 57 26 - TEXAS POLLUTION DISCHARGE ELIMINATION SYSTEM (TPDES)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This project is subject to the Texas Commission on Environmental Quality (TCEQ) Texas Pollution Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements. The Contractor will be required to execute a Notice of Intent (NOI) and implement the Pollution Prevention Plan included in the Contract Documents and comply with all reporting and inspection requirements set forth in the TPDES regulations.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Supplementary Conditions, and relevant Division 2 Specification Sections, apply to this Section.

1.3 SUMMARY

A. The Contractor shall be responsible for the preparation, implementation, maintenance, and inspection of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking and other practices described in the Storm Water Pollution Prevention Plan (SWPPP) Drawing, and as specified elsewhere in this or other Technical Specifications.

B. Contractor shall present his plan for implementation of the SWPPP in a meeting with the Owner/Architect/Engineer prior to start of construction.

1.4 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. The components shall consist of the control measures necessary to comply with the NPDES and The Clean Water Act. Example erosion and sediment control measure components are found on the Storm Water Pollution Prevention Plan Drawing, and this or other Technical Specifications.

PART 3 - EXECUTION

3.1 NOTICE OF INTENT / CERTIFICATION REQUIREMENTS

A. The Contractor shall execute, along with the Contract Documents, a Contractor/Subcontractor Certification, which shall identify the responsibilities for construction activity during the contract. Each Subcontractor’s responsibility with regard to the SWPPP shall be identified.

B. The Contractor shall be responsible for signing the certification statement of the NOI.

C. A copy of the NOI shall be posted in a prominent place for public viewing at the project site. The Contractor shall be responsible for execution of all documents and providing all inspections and certifications outlined in the SWPPP as necessary for compliance with federal, state and local guidelines.

D. The executed Notice of Intent shall be sent to:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC-228
P.O. Box 13087
Austin, Texas 78711-3087

3.2 RETENTION OF RECORDS

A. The Contractor shall retain a copy of the SWPPP from the date that it became effective to the date of project completion.

B. Contractor shall retain copies of all inspection and maintenance reports, as well as copies of all modifications and adjustments to the SWPPP until the date of project completion.

C. Contractor shall return to the Owner, all records stated above at the completion of the project. Owner will retain all SWPPP records and data for a period of three (3) years from the date project completion.

3.3 REQUIREMENTS

A. The following notices are to be posted from the date that the SWPPP goes into effect until the date of final stabilization:
1. Copies of the Notice of Intent, submitted by the Owner and General Contractor, along with the Project Description Form of the SWPPP, are to be posted at the construction site or at the Contractor's office in a prominent place for public viewing.
2. Notice to drivers of equipment/vehicles to stop, check, and clean tires for debris and mud before equipment/vehicles can enter traffic lanes are to be posted at every stabilized construction exit area.
3. Notice of waste disposal procedures are to be posted at a location onsite.
4. Notice of hazardous material handling and emergency procedures are to be posted with the NOI on site. Copies of Material Safety Data sheets are to be kept at a location onsite that is clearly made known to all personnel.
5. A copy of the signed Certification forms included in this Section shall be kept at the construction site or at the Contractor's office.

B. Construction may not begin until 60 days after the NOI is filed.

C. Construction sites that will disturb 10 acres or more shall meet current numeric discharge limit requirements.

D. If earth disturbance will be stopped for 14 days or more, the contractor must immediately stabilize the area using straw or hydraulic mulch, soil binders, erosion control blankets, or hydroseeding.

3.4 NOTICE OF TERMINATION

A. A Notice of Termination (NOT) of Coverage under the TPDES General Permit for Storm Water

Discharges Associated with Industrial Activity and storm water run-off from the construction activities does not cause sediment transport or erosion from the site. The A/E and inspector will make final determination of the final stabilization. Final stabilization is when all soil-disturbing activities at the site have been completed and when a uniform perennial vegetative cover with a density of 85% of the cover for unpaved areas has been established. The Contractor will be required to maintain structural controls until this vegetative cover meets the above requirement.

3.5 ATTACHMENTS

For the current forms, visit the TCEQ's website at:
https://www.tceq.texas.gov/assistance/water/stormwater/sw-construction.html#tpdes.

END OF SECTION 01 57 13.15

SECTION 01 60 13 - EXTERIOR DESIGN SELECTIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes a schedule summary of Design Selections for materials and finishes technically specified in various technical Sections of this Project Manual.

1.3 PROCEDURES

A. References in this Section to specific manufacturer, model name and model number, are to establish preferred design selection standard only. Other "Acceptable Manufacturers" listed in the technical section, if qualified, are allowed to submit in accordance with Division 1 Section "Product Requirements".

B. Each material selection is referenced by Section name and number to where it is specified.

1.4 SELECTIONS BY SECTION

03 35 00 – Concrete Finishing

Sealed Concrete (SC): Penetrating liquid floor hardener; refer to technical section for requirements.
Finish: Light Broom.

04 20 00 – Unit Masonry

BK-1: Face Brick
Manufacturer: Kansas Brick – Upchurch Kimbrough
Color / Finish: 500 Charcoal
Size: Utility
Mortar Color: TBD
Location: As indicated on the Drawings.

05 50 00 – Metal Fabrications

HPP-1: High Performance Paint
Basis of Design: Tnemec Series 90-97 Tneme-Zinc,
Type: Zinc-Rich Aromate Urethane match Sherwin Williams
Color: Tricorn Black, SW 6258.

07 42 13 – Metal Wall Panels

MWP-1
Manufacturer: PAC-CLAD
Type: Flush metal wall panel
Color: T.B.D

MWP-2 -Metal Panel
Manufacturer: PAC-CLAD
Type: Box Rib 3-Box Rib 4
Color: T.B.D

MWP-3
Manufacturer: PAC-CLAD
Type: Reveal metal wall panel

MWP-4
Manufacturer: PAC-CLAD
Type: Reveal metal wall panel

MCM-1 Metal Panel Composite
Manufacturer: Alucobond
Color: T.B.D.

08 11 13 – Hollow Metal Doors and Frames
Color: Reference Door Schedule.

08 41 13 – Aluminum Framed Entrance and Storefront and Curtain Wall
SF-1&2: Basis of Design Manufacturer: Kawneer North America; an Alcoa Company.
Basis of Design Product: Trifab 451.
Finish / Color: Clear Anodized.

CW 1-5: Basis of Design Manufacturer: Kawneer North America; an Alcoa Company.
Basis of Design Product: 1600.
Finish / Color: Clear Anodized.

08 80 00 – Glazing

GL-1 **Clear Insulated Vision Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) clear tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite.

GL-2 **Clear Insulated Spandrel Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) clear tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite with Charcoal Gray Opaci-Coat (#4).

GL-3 **Gray Insulated Vision Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) Gray tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite.

GL-4 **Red Insulated Vision Glass:** 1-1/16 inch (25 mm) sealed insulated unit consisting of an exterior lite of 3/16 inch (5 mm) clear tempered float glass, .090 PVB Vanceva Interlayer (Color: 0C1C), 3/16 inch (5mm) clear tempered float glass, 3/8 inch (8mm) air space, and ¼ inch (6mm) SunGuard SNX 60+ low-e (#5) clear tempered float glass interior lite.

GL-5 **Gray Insulated Spandrel Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) gray tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite with Charcoal Gray Opaci-Coat (#4).

GL-6 **Red Insulated Spandrel Glass:** 1-1/16 inch (25 mm) sealed insulated unit consisting of an exterior lite of 3/16 inch (5 mm) clear tempered float glass, .090 PVB Vanceva Interlayer (Color: 0C1C), 3/16 inch (5mm) clear tempered float glass, 3/8 inch (8mm) air space, and ¼ inch (6mm) SunGuard SNX 60+ low-e (#5) clear tempered float glass interior lite with Charcoal Gray Opaci-Coat (#6).

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 01 60 13

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 PRE-CLOSEOUT MEETING

A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00, Project Management and Coordination.

1.3 SUBSTANTIAL COMPLETION

A. The items listed in the Supplementary Conditions, Paragraph 9.8 and the following items shall be completed before Substantial Completion will be granted:
   1. Contractor's Completion List (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work or portion of the Work. The Architect/Engineer's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
   2. Architect's Supplemental Punch List: The Architect/Engineer, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
   3. Operations and Maintenance Manuals: Submit as described in paragraph 1.3.
   4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in paragraph 1.6 and 1.7.
   5. Starting of systems: Start up equipment and systems as described in paragraph 1.8.
   6. Testing and balancing: Testing and balancing of systems must be performed and completed by Owner's forces, and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
   7. Demonstrations: If required by individual specification sections or by Owner, provide demonstrations and instructions for use of equipment as described in paragraph 1.9.

B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.

C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.

1.4 PUNCH LIST

A. A comprehensive list prepared by the Contractor prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of work to be completed, if any. This list is intended to represent a limited number of items needing attention.

B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
   1. Room number or other suitable location identifier
   2. Description of the work
   3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
   4. Sub-contractor/trade sign-off date
   5. General contractor sign-off that the work has been verified to be I 00% complete and in accordance with the Contract Documents
   6. General contractor/trade sign-off date
   7. A/E consultant sign-off
   8. A/E consultant sign-off date
   9. If requested by the Owner, provide two additional similar columns for their sign-off.
   10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the contractor/sub-contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.

C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for re-inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.

D. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion will be no longer than five (5) typed pages.

E. The Contractor's superintendent shall participate in the preparation of the Contractor's punch list that is submitted to the Architect and Owner for supplementation. Upon receipt, the Architect and Consultants shall perform a spot review to determine the adequacy and completeness of the Contractor's punch list.

F. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany the Architect, his Consultants and the Owner (at his discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
   1. The Superintendent shall record or otherwise take note of all supplementary items.
   2. The Architect will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the Contractor's receiving said supplements from the Architect will not be cause for a claim for additional cost or extension of time as the Contractor's Superintendent shall have been in attendance during the inspections of the Architect and his Consultants and will have been expected to take his own notes.

1.5 OPERATIONS AND MAINTENANCE MANUAL

A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.

B. Prepare 3-ring D-slant binder cover and spline with printed title "OPERATIONS AND MAINTENANCE MANUAL", title of project, and subject matter of binder when multiple binders are required.

C. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, *etc*.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Equipment start-up instructions
      e. Operating instructions.
      f. Maintenance instructions for equipment and systems.
      g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

   3. Part 3: Project documents and certificates, including the following:
      a. Product data.
      b. Air and water balance reports.
      c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.

G. Submit one (1) final original and two (2) copies to Architect.

H. Contractor shall provide a DVD, in PDF Format, the following documents after approval by the Architect, Consultants and Owner: closeout manual, MSDS binder, O&M Manuals, specifications and approved submittals. Documents shall be hyper-linked to the Table of Contents.

1.4 PROJECT CLOSEOUT

A. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
   1. Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to the Supplementary Conditions, Paragraph 9.10 for additional information.
   2. Record Documents: Submit as described in paragraph 1.10.
   3. Extra materials: Provide extra stock, materials, and products as described in paragraph 1.11 when required by individual specification sections.

4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.
7. Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.

1.5 CLOSEOUT DOCUMENTS

A. Coordinate the following items with the requirements of Document CB, Supplementary Conditions of the Contract.

B. Prepare 3-ring D-slant binder cover and spline with printed title "CLOSEOUT DOCUMENTS", title of project, and subject matter of binder when multiple binders are required. Submit one (1) original and two (2) copies.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and Owner. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.

E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper, in five (5) parts as follows:
1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. All General Contractor's vendors/suppliers and subcontractors that provided materials or performed any work related to this project must be listed on this form. Submit Final List of Subcontractors on Document AD.
2. Part 2: Closeout Documents and Affidavits, include the following:
   a. AIA G707 - Consent of Surety to Final Payment;
   b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims;
   c. AIA G706A - Contractor's Affidavit of Release of Liens;
3. Part 3: Project documents and certificates, including the following:
   a. Copy of Certificate of Substantial Completion (AIA G704);
   b. Copy of All Permits;
   c. Copy of Final Utility Bill or letter of transfer;
   d. Copy of Certificate of Occupancy;
   e. Copy of Certification of Project Compliance: Submit on attached **Close-out Form "B"**. Owner and Architect will initiate form and forward to Contractor for signature once Substantial Completion is established. (Owner to be provided original separately);
4. Part 4: Warranties, Release of Liens, compile sequentially based on specification sections:
   a. General Contractor's Warranty: Submit on company letterhead as described below. This Warranty shall state all sections of Work performed by General Contractor's own forces, and warranty period for each section of Work;
   b. Subcontractor's Release of Lien: Include contractor's, subcontractor's and direct material and equipment supplier's separate final releases. Submit on attached **Close-out Form "A"** – Subcontractor's Affidavit of Release of Lien.

c. Hazardous Material Certificate: Submit on attached **Close-out Form "C"**. Affidavits from Contractor, Subcontractors and General Contractor's vendors or suppliers stating that no hazardous materials/products have been used or installed in this project.
d. Subcontractor's Warranty: notarized, and submitted on attached **Close-out Form "D"**. This Warranty shall state all sections of Work performed by the subcontractor and warranty period.
e. Special / Extended Warranties; List and provide, notarized warranties requested by Owner, or required by or incorporated in the Contract Documents.
f. Spreadsheet depicting all items and materials that carry a warranty longer than one (1) year. Include information consisting of material/ supplier/ installer/ specification section/ length of warranty and contact information.

5. Part 5: Receipts:
a. Extra Stock: Provide original receipts for delivery of "Extra Stock" items as described below. Receipts must be signed by an authorized Owner's representative;
b. Keys: Provide original receipts for delivery of "Keys". Receipts must be signed by an authorized Owner's representative.
c. Sign in sheets: provide signatures of attendees from all demonstrations.

F. In addition to the three (3) required close-out binders listed above, provide Architect with one (1) separate binder for their records containing the following:
1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers;
2. All MSDS sheets for the project;
3. All warranties from Contractor, subcontractors, direct suppliers, and manufacturers.

G. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

H. Release of retainage shall not be made until all closeout documents and records have been accepted as final.

1.6 FINAL CLEANING

A. Execute final cleaning prior to final project inspection and acceptance.

B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.

C. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces

D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

E. Clean and replace filters of operating equipment as required by Contract Documents

F. Clean debris from roofs, gutters, downspouts, and drainage systems.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.7 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.8 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.

G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.9 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner’s requirements.

B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.

D. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.

F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.

G. Review and verify proper star-up and operation of equipment prior to scheduling demonstrations with Owner.

H. All demonstrations are to be documented by video and submitted to the Owner in DVD format along with the close out documents. General contractor is responsible for all video and compilation onto DVD with linked menus.

1.10 PROJECT RECORD DOCUMENTS

A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect and Engineers is achieved in accordance with the Owners requirements.

B. At the Contractors request, and with associated fee, Architect may provide electronic versions of the construction drawing and specification files for Contractors use, subject to the terms and conditions of Architects standard electronic document transfer agreement.

C. Submit reproducible to respective consultants (Civil, Structural, MEP, *etc*.) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
   1. Format: One (1) set of film positive reproducibles and two (2) sets bluelines of approved reproducibles.
   2. Provide the Owner with one (1) set of Record Drawings on (1) thumb drive a non-rewritable DVD in AutoCAD® latest release.
   3. Provide the Owner with one (1) set of Record Drawings on a on (1) thumb drive a non-rewritable DVD in PDF format.
   4. Label electronic CAD files and PDF files in the same manner as the sheets (example, A2.02 First Floor Area ‘A’, etc.)

1.11 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site or to District Maintenance Department as directed by Owner; obtain signed receipt from Owner’s authorized representative prior to final application for payment. Delivery of materials to or obtaining receipt from anyone other than Owner’s authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.

C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.

1.12 WARRANTIES, CERTIFICATES AND BONDS

A. Definitions:
   1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
   2. Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.

B. In accordance with the general warranty obligations under Paragraph 3.5 of the General Conditions as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractors one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

C. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under Paragraph 12.2 of the General Conditions.

D. No service charges or call out charges are allowed to investigate warranty claims.

E. In addition to the Contractors one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.

F. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

G. Warranty Requirements:
   1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
   2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
   3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
   4. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
   5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

H. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warrantees with Closeout Documents submitted to the Architect.

1.13 FINAL COMPLETION AND FINAL PAYMENT

A. Final Notice and Inspection:
   1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to the Architect that the Work is ready for final inspection and acceptance.
   2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, the Architect and Engineer will make final inspection.

B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.

C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.

D. Release of Retainage: Release of retainage will not be authorized by the Architect until Contractor completes all requirements for close-out to the satisfaction of the Owner and Architect as described herein.

1.14 TERMINAL INSPECTION

A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.

B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.

C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 77 00

SECTION 01 77 00 CLOSEOUT FORMS

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the_____of_____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

   Project: **Tomball Multi-Program Activity Centers**
   Owner: Tomball Independent School District Architect: PBK
   Work Performed:_____Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.

3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.

4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

_____
Name of Subcontractor

_____ _____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this_____day of_____, 20_____.

_____
(Seal) (Notary Public Signature)

CLOSE OUT FORM "B"

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

Facility:

Address:

City:

DISTRICT: Tomball Independent School District

ARCHITECT/ENGINEER: PBK Architects

CONTRACTOR/CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: **BY:** **DATE:**

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER: **BY:** **DATE:**

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM: **BY:** **DATE:**

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: **BY:** **DATE:**

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:
- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1033 or §61.1036, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____ PROJECT: Tomball Multi-Program Activity Centers

COUNTY OF _____ OWNER: Tomball Independent School District

ARCHITECT: PBK Architects

SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she is the _____ of _____, the subcontractor / supplier who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing products have been incorporated into the project.

ATTEST (If Corporation)

_____
Name of Subcontractor / Supplier

_____ _____
Secretary (By) (Title)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

_____
(Seal) (Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the_____of_____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

   Project: Tomball Multi-Program Activity Centers Owner: Tomball Independent School District Architect: PBK Architects Work Performed: Specification Section(s):
   _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.

4. The Subcontractor warrants the work performed for a period of_____months from the date of Substantial Completion, except as follows:_____
   _____

ATTEST (If Corporation)

_____
Name of Subcontractor

_____
Secretary (By) (Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this_____day of_____, 20____.

_____
(Seal) (Notary Public Signature)

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative and procedural requirements for project record documents, including but not limited to:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings:
   1. Number of Copies: Submit one set of marked up record prints.
   2. Number of Copies: Submit copies of record Drawings:
      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints and one of file prints.
         2) Submit record digital data files and one sets of plots.
         3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three sets of prints.
         2) Submit record digital data files and three sets of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and one annotated PDF electronic file and directory of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked up Product Data as a component of manual.

D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

A. Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference.

1. Do not use As Built Drawings and Specifications for Record Drawings and Specifications.

B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.

C. Store Record Documents and samples apart from as built documents used for construction.
1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document *PROJECT RECORD* in neat, large, printed letters.
2. Maintain Record Documents in clean, dry and legible condition.
3. Make Record Documents and samples available for inspection upon request of Architect.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally.
   a. Give attention to information on concealed elements difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross reference record prints to corresponding shop drawings or archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.
4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
   a. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.
   b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.

2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation PROJECT RECORD DRAWINGS.
   d. Name of Architect.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 RECORD SAMPLES

A. Record Samples: Determine with Architect and Owner which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
1. Reviewed shop drawings, product data, and samples.
2. Field test reports.
3. Inspection certificates and manufacturer's certificates.
4. Inspections by authorities having jurisdiction (AHJ).
5. Documentation of foundation depths.
6. Special measurements or adjustments.
7. Tests and inspections.
8. Surveys.
9. Design mixes.

B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.
   4. O&M Manuals should be uploaded into Owner’s designated software (Prolog)

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Contractor.
      e. Date of video recording.

   2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.

i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish an instructor to describe Owner's operational philosophy.
   2. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

   1. Schedule training with Owner through Program Manager with at least 10 days' advance notice.

C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove

instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

END OF SECTION 01 79 00

Tomball ISD High School Athletic Improvements

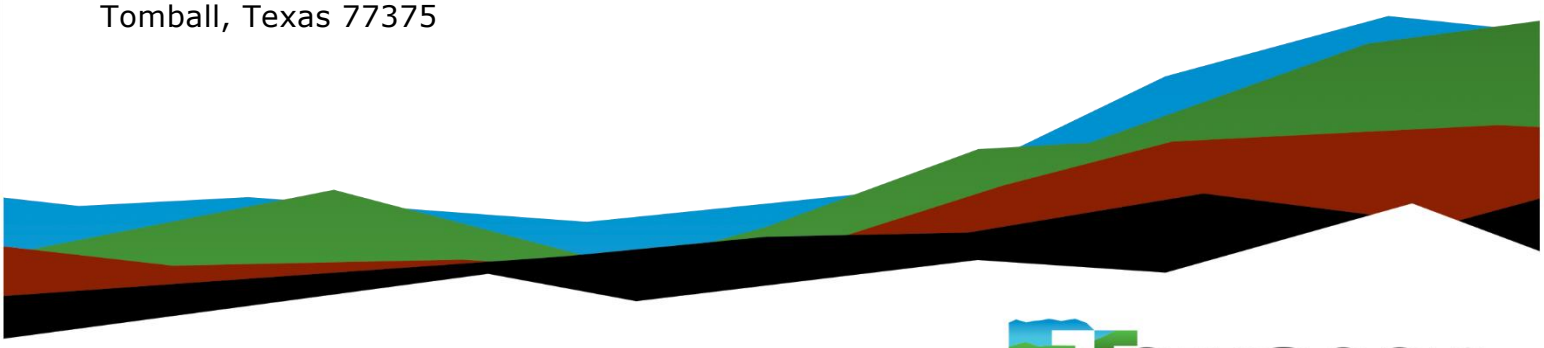
Geotechnical Engineering Report

Tomball, Texas

April 21, 2026 | Terracon Project No. 92265050

Prepared for:

Tomball Independent School District
310 South Cherry Street
Tomball, Texas 77375



Terracon
Explore with us

Nationwide
Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials

11555 Clay Road, Suite 100
Houston, Texas 77043
P (713) 690-8989
Terracon.com

April 21, 2026

Tomball Independent School District
310 South Cherry Street
Tomball, Texas 77375

Attn: Mr. Zachery Boles – Chief Financial Officer
P: (281) 357-3100
E: zacheryboles@tomballisd.net

Re: Geotechnical Engineering Report
Tomball ISD High School Athletic Improvements
30330 Quinn Road
Tomball, Texas
Terracon Project No. 92265050

Dear Mr. Boles:

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the project referenced above in Tomball, Texas. We trust that this report is responsive to your project needs.

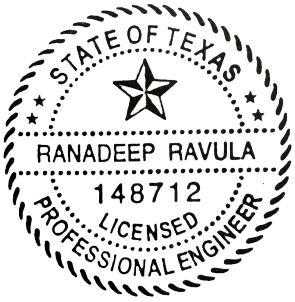
We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.
(Texas Firm Registration No.: F-3272)

Kevin Chavez

Kevin Chavez
Staff Geotechnical Professional



Ranadeep Ravula, P.E.
Group Manager

Table of Contents

Introduction **1**
Project Description **2**
Site Conditions **3**
Geotechnical Characterization **3**
Geology 4
GeoModel 4
Groundwater Conditions 5
Geotechnical Overview **6**
Earthwork **8**
Site Preparation 8
Fill Material Types 8
Fill Compaction Requirements 9
Utility Trench Backfill 10
Grading and Drainage 10
Wet Weather/Soft Subgrade Considerations 11
Foundation Systems **11**
Design Recommendations – Shallow Spread/Strip Footings (MPAC Building, Bleachers, Press Boxes, and Arched Entry) 12
Construction Considerations – Shallow Spread/Strip Footings (MPAC Building, Bleachers, Press Boxes, and Arched Entry) 13
Design Recommendations – Drilled Straight Shafts (MPAC Building) 13
Construction Considerations – Drilled Straight Shafts 16
Design Recommendations – Drilled-and-Underreamed Footings (Bleachers, Press Box, and Arched Entry) 18
Construction Considerations – Drilled-and-Underreamed Footings 19
Grade Beams – Drilled-and-Underreamed Footings 20
Foundation Construction Monitoring 20
Floor Slab **20**
Pavements **21**
General Comments **25**

Figures

GeoModel

Attachments

Exploration and Testing Procedures
Site Location and Exploration Plans
Exploration and Laboratory Results
Supporting Information

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Introduction

Terracon Consultants, Inc. (Terracon) is pleased to submit our Geotechnical Engineering report for the proposed construction of a two-story multipurpose activity center (MPAC) building, Bleachers, and press boxes, arch entry gate, and associated pavements planned within the existing Tomball High School located at 30330 Quinn Road in Tomball, Texas. This project was authorized by Mr. Mitchell Lee, E.D. through signature of the AIA® Document B221™ - 2018 between Tomball Independent School District (TISD) and Terracon dated March 18, 2026. This project was performed in general accordance with Terracon Document No. 92265050, dated February 6, 2026.

The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Boring logs with field and laboratory data;
- Description of subsurface conditions;
- Groundwater levels observed during drilling;
- Site and boring location plans;
- Demolition considerations;
- Site and subgrade preparation recommendations;
- Foundation design and construction recommendations;
- Requirements for fill to be used on-site, including engineering properties and placement and compaction for the backfilling of the existing detention pond;
- Pavement design guidelines.

The geotechnical engineering Scope of Services for this project included the advancement of 9 test borings, laboratory testing, engineering analysis, and preparation of this report.

Maps showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the **Exploration and Laboratory Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Proposed Improvements[1]	■ A two-story multipurpose activity center (MPAC) high school building with an approximate footprint area of 65,000 square feet (sf). ■ Bleachers and press boxes at both the baseball and softball fields. We understand the bleachers and press boxes are planned to be elevated. In addition, we understand the concrete flatwork in the bleachers and press box areas is planned to be designed for a PVR of one inch or less. ■ An arched entry gate. ■ Associated surface pavements and driveways. ■ We understand that a portion of the existing detention pond with an assumed maximum depth of 12 feet located on the southeast side of the proposed building is planned to be backfilled. We understand that a portion of the proposed fire lane loop will traverse over the backfilled portion of the existing detention pond which is expected to be about 8 to 10 feet of backfill. ■ We understand that the existing detention pond has not yet been backfilled and the proposed MPAC building is not anticipated to be located within the limits of the pond backfill area.
Building Construction[1]	Combination of steel-frame and concrete masonry unit (CMU) construction with either grade-supported floor slab or a structurally suspended and supported floor slab system.
Finished Floor Elevation[1]	We understand that the finished floor elevation (FFE) is planned to be 200 feet, which is approximately 4 to 7 feet above existing grade.
Maximum Loads[1]	■ **Column loads**: Up to 400 kips[1] ■ **Floor slab pressure**: 125 pounds per square foot (psf)
Planned Foundation Systems	■ **MPAC Building:** Shallow spread/strip footings or drilled straight shafts. ■ **Bleachers, press boxes, and arched entry:** Either shallow spread footings or drilled-and-underreamed footings.

Item	Description
Pavements[1]	We understand that rigid (concrete) pavement sections are being considered.
Anticipated Traffic	■ Consists primarily of passenger vehicles in the parking areas and passenger vehicles combined with garbage trucks, buses, and large multi-axle delivery trucks from time-to-time in driveway areas. ■ We anticipate the traffic load on the fire lane will consist of the light passenger car traffic and a 75,000 pound truck one to two times a year.

1. Based on the information provided by LAN.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration.

Item	Description
Project Location	The project is within the existing Tomball High School located at 30330 Quin Road in Tomball, Texas. See **Site Location**.
Existing Improvements	The western portion of the site, where the MPAC building is planned, was an existing practice field area, with an existing detention pond located to the southeast of the proposed MPAC building. A soil mound with a maximum height of about 10 feet was located on the southeastern portion of the proposed MPAC building. The eastern portion of the site appears to be occupied by softball and baseball fields, along with associated gravel and concrete pavements.
Current Ground Cover	Grass, weeds, gravel roadways.
Existing Topography	Relatively level.

Geotechnical Characterization

Geology

Based on the geologic maps published by the Bureau of Economic Geology, the site for the proposed construction is located on the Willis Formation, the oldest formation of the Houston group. The Willis formation was deposited early in the Pleistocene epoch, during the Aftonian Interglacial Stage. It is fluviatile, consisting of sands, silts, and clays in approximately equal amounts. It is on the order of 200 foot thick in full section.The formation grades generally from coarse sands at its basal contact with the soils of the older Fleming Group to sandy clays near its contact with the overlying lower Lissie (Bently) formation. Indurations of ferrous particles and siliceous gravel are frequent. Siliceous and ferrous compounds also serve as cementing agents in many of the sandy clay strata.

The clays are deeply weathered lateritic soils and have been highly overconsolidated, apparently by a process of desiccation. The sands are generally coarser and better graded than those of younger formations nearer the coast. The soils, both clays and sands, are therefore quite strong and are capable of supporting structural loadings without undue distress.

The coastal plain in this region has a complex tectonic geology, several major features of which are: Gulf Coastal geosyncline, salt domes, and major sea level fluctuations during the glacial stages, subsidence and geologic faulting activities. Most of these geologic faulting activities have ceased for millions of years, but some are still active. A detailed geologic fault investigation and study of the site geology are beyond the scope of this report.

GeoModel

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration and Laboratory Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Fill: Sandy Lean Clay and Poorly Graded Sand with Silt**	dark gray, with scattered gravel
2	**Sandy Lean Clay and Sandy Silty Clay**	dark gray, tan, reddish brown, and light gray, very soft to hard, with ferrous stains and nodules
3	**Silty Sand and Clayey Sand**	light gray, reddish brown, dark gray, and tan, very loose to very dense, with clay pockets
4	**Fat Clay and Sandy Fat Clay**	reddish brown and light gray, very stiff to hard, with slickensides

Groundwater Conditions

Borings B-1 through B-5 were advanced using dry drilling techniques to a depth of approximately 15 to 25 feet in an effort to evaluate groundwater conditions at the time of our field program. Wet rotary techniques were used thereafter to their termination depths (about 30 to 50 feet). Borings B-6 through B-9 were advanced using dry drilling techniques to their termination depths (about 5 to 20 feet) in an effort to evaluate groundwater conditions at the time of the field program. Upon reaching groundwater, drilling was suspended for a period of about 15 minutes to allow the groundwater to rise and the groundwater levels to be recorded. The water levels observed in the boreholes can be found on the boring logs in **Exploration and Laboratory Results** and are summarized below.

Summary of Groundwater Level Observations[1]					
Boring No.	**Approximate Boring Depth (feet)[2]**	**Depth of Dry Drilling (feet)[2]**	**Approximate Depth of Groundwater (feet)[2]**		
			Initial/ During Dry Drilling	**After 5 Minutes**	**After 15 Minutes**
B-1	30	23	23	21	18½
B-2	30	25	25	21	18
B-3	30	17	22	17	15
B-4	30	20	20	18	17
B-5	50	15	15	12	10
B-6	20	20	No free water observed		

Summary of Groundwater Level Observations[1]					
Boring No.	Approximate Boring Depth (feet)[2]	Depth of Dry Drilling (feet)[2]	Approximate Depth of Groundwater (feet)[2]		
			Initial/ During Dry Drilling	After 5 Minutes	After 15 Minutes
B-7	20	20	No free water observed		
B-8	20	20	No free water observed		
B-9	5	5	No free water observed		

1. Groundwater readings were obtained from March 20, 2026 to March 24, 2026.
2. Below existing grade.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project and should be evaluated prior to construction.

Geotechnical Overview

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. A summary of our findings and recommendations is provided below.

- Fill soils were observed at the ground surface at borings B-6 through B-9, within the proposed bleachers and press boxes, and extended to a depth of about 2 feet. Fill soils may be present at varying depths and at other locations not explored during our field program. Support of the foundation elements, slabs, flatworks, and pavements on or above fill soils is discussed in this report. However, even with the recommended construction testing services, an inherent risk exists for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill.

- Due to the amount of the fill observed at the proposed bleachers and press box areas, we recommend that the fill soils be over-excavated and completely removed within the proposed structure areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed structure areas.

- The surficial soils observed at the site exhibited negligible to low plasticities and an increased silt and sand content. These soils are moisture sensitive and may become weak with elevated moisture contents and present construction difficulties. If wet and/or soft conditions are present at the time of construction, remedial efforts may be necessary for preparation of the surficial soils in the building and pavement areas to create a working surface. Remedial effort options are discussed in the **Wet Weather/Soft Subgrade** section of this report.

- A foundation system consisting of either shallow spread/strip footings or drilled straight shafts may be utilized to support the proposed building planned at this site.

- A foundation system consisting of either drilled-and-underreamed footings or shallow spared footings may be utilized to support the proposed structures planned at this site.

- Based on the subsurface conditions observed, the installation of drilled straight shafts will likely require the use of the Slurry Displacement Method and/or temporary steel casing due to the presence of sandier/siltier zones and groundwater. If drilled shaft installation is attempted without utilizing Slurry Displacement Method or temporary casing, zones of sloughing soils and/or groundwater inflow may occur during construction.

- A minimum 12-inch thick select fill pad should be placed under the proposed MPAC building/flat work areas within bleachers and press box areas to provide uniform support to the floor slab/slabs. We understand that the finished floor elevation (FFE) is planned to be 200 feet, which is approximately 4 to 7 feet above existing grade within the MPAC building area. Select fill soils should be used to raise grade up in the proposed MPAC building area.

- We understand that the existing detention pond is planned to be backfilled to facilitate the construction of proposed improvements. We understand that a portion of the proposed fire lane loop will traverse over the backfilled portion of the existing detention pond which is expected to be about 8 to 10 feet of backfill. Recommendations of backfilling the existing pond are provided in the **Earthwork** section of this report.

- Rigid pavement sections vary from 5.0 to 7.0 inches of reinforced concrete with chemically treated subgrade.

This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **General Comments** should be read for an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slab, and pavements.

Site Preparation

Construction areas should be stripped of vegetation, topsoil, and other debris/unsuitable surface material. Care should be taken to replace or recompact all soil removed or loosened by the removal of tree roots and stumps as recommended in subsequent paragraphs. Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Due to the amount of the fill observed at the proposed bleachers and press box areas, we recommend that the fill soils be over-excavated and completely removed within the proposed structure areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed structure areas.

The existing pond should be properly stripped and de-mucked. De-mucking should include the removal of all soft and wet soils within the pond and adjacent areas. De-mucking should extend to the depth of competent material. The exposed soil subgrade area should be visually observed by the Geotechnical Engineer of his/her representative. Weak and wet areas should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils.

Subsequent to proofrolling, and just prior to placement of fill, the exposed subgrade within the construction area should be evaluated for moisture and density. If the moisture and/or density do not meet the criteria described in **Fill Compaction Requirements** for on-site soils, the subgrade should be scarified to a minimum depth of 6 inches, moisture adjusted, and compacted to at least 95 percent of the Standard Effort (ASTM D698) maximum dry density.

Fill Material Types

Select fill and on-site soils to be used at this site for grade adjustments should meet the following criteria:

Fill Type	USCS Classification	Acceptable Location for Placement
Select Fill Soils	CL and/or SC (10≤PI≤20)	Must be used to construct the select fill building pad under the floor slab, flat work areas within bleachers and press box areas, for backfilling the existing detention pond in the fire lane area, and for all grade adjustments within the building area.
On-site Soils[1]	Varies	■ The on-site soils, including the undocumented fill soils, appear suitable for use as fill within the pavement areas, provided they are free of organics and debris. ■ If the fire lane location is moved away from the existing detention pond area the on-site soils should be used within the pond backfill, provided they are free of organics and debris.

1. The utilization of on-site silt/sand soils may present difficulties during construction due to the increased sand and silt content of these soils, especially during and soon after periods of wet weather. If the utilization of the silt/sand soils as fill is planned in the pavement areas, treatment of these soils with lime-flyash should produce a material that would be more suitable for use as fill.

If blended or mixed soils are intended for use as select fill, Terracon should be contacted to provide additional recommendations. These soils are a blend of sand and clay and will require mechanical mixing at the site with a pulvimixer. If these soils are not mixed thoroughly to break down the clay clods and blend-in the sand to produce a uniform soil matrix, the fill material may be detrimental to the performance of the foundations. If blended soils are used, we recommend that additional samples of the blended soils as well as the clay clods, be obtained prior to and during earthwork operations to evaluate if the blended soils can be used in lieu of select fill. The actual type and amount of mechanical mixing at the site will depend on the amount of clay and sand, and properties of the clay.

Fill Compaction Requirements

Item	Description
Fill Lift Thickness	The fill soils should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches.

Item	Description
Compaction Requirements	■ The select fill and on-site soils placed below 4 feet below final grade should be compacted to at least 100 percent of the Standard Effort (ASTM D698) maximum dry density. ■ The select fill and on-site soils placed within 4 feet below final grade should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density. ■ The select fill and on-site soils should be moisture adjusted to within 2 percent of the optimum moisture content.

Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the structures should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the structures. We recommend constructing an effective clay "trench plug" that extends at least 5 feet out from the face of the structure's exterior. The plug material should consist of clay compacted at a water content at or above the soils optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

Grading and Drainage

All grades must provide effective drainage away from the structures during and after construction. Water permitted to pond next to the structures can result in distress in the structures. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. Slab and foundation performances described in this report are based on effective drainage for the life of the structures and cannot be relied upon if effective drainage is not maintained.

Exposed ground should be sloped away from the structures for at least 10 feet beyond the perimeter of the structure. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary, as part of the structure's maintenance program.

Planters located within 10 feet of the proposed structures should be self-contained to prevent water accessing the building and pavement subgrade soils. Locate sprinkler mains and spray heads a minimum of 5 feet away from the building lines. Low-volume, drip-style landscaped irrigation should not be used near the structures. Collect roof runoff in drains or gutters. Discharge roof drains and downspouts onto pavements and/or flatworks which slope away from the proposed structures or extend down spouts a minimum of 10 feet away from structures.

Flatworks and pavements will be subject to post construction movement. Maximum grades practical should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the building, effectively seal and maintain joints to prevent surface water infiltration.

Wet Weather/Soft Subgrade Considerations

Due to the elevated silt and sand content and negligible to low plasticities of the surficial soils observed at this site, proper compaction may be difficult to achieve. In addition, construction during and soon after wet weather periods may encounter difficulties due to wet and soft surficial soils becoming a general hindrance to equipment as a result of rutting and/or pumping of the soil surface. This condition is primarily due to their lack of cohesion (low clay content) and little to no confining pressure near the ground surface. If the subgrade cannot be adequately compacted to the minimum densities as described above, one of the following methods should be used to improve the soils: 1) removal and replacement with select fill, 2) chemical treatment of the soil to dry the subgrade, or 3) drying by natural means if the schedule allows.

Based on our experience with similar soils, chemical treatment is an efficient and effective method to improve the condition of wet and soft subgrade such as that observed at this site. Chemical treatment may be necessary to depths of approximately one to 2 feet or greater of the surficial silty/sandy soils, depending on the condition of the subgrade at the time of construction. We suggest that a cost be included in the construction budget for chemical treatment of the soils using a lime-flyash mixture to aid drying and improve the condition of the soil if the soil is wet and/or soft at the time of construction. We recommend that this cost be in the form of a contingency or allowance to be used if needed.

Foundation Systems

Based on the subsurface conditions observed during our field and laboratory programs, a foundation system consisting of either shallow spread/strip footings or drilled straight shafts may be utilized to support the proposed MPAC building planned at this site, and a

foundation system consisting of either shallow spread footings or drilled-and-underreamed footings may be utilized to support the proposed bleachers, press boxes, and arched entry planned at this site, provided the subgrade is properly prepared as described in this report. Recommendations for these types of foundation systems are provided in the following sections, along with other geotechnical considerations for this project.

Design Recommendations – Shallow Spread/Strip Footings (MPAC Building, Bleachers, Press Boxes, and Arched Entry)

Item	Description	Bleachers, Press Boxes, and Arched Entry
Minimum Embedment Depth	4 feet below final grade[1]	4 feet below existing grade (grade at the time of our field program)[2]
Allowable Bearing Pressures (Individual Footings) [3]	Net dead plus sustained live load – 2,100 psf Net total load – 3,100 psf	
Allowable Bearing Pressure (Strip Footing) [4]	Net dead plus sustained live load – 1,700 psf Net total load – 2,500 psf	---
Approximate Post-Construction Settlement [5]	Approximately one inch	
Estimated Post-Construction Differential Settlement [6]	Approximately ½ of post-construction settlement	
Allowable Passive Pressure [7]	750 psf	
Allowable Frictional Resistance [8]	250 psf	
Uplift Resistance [9]	Foundation Weight (150 pcf) & Soil Weight (120 pcf)	

1. The footings should bear upon the properly placed and compacted select fill soils.
2. The footings should bear upon the native undisturbed clay soils.
3. Whichever condition yields a larger bearing area.
4. Defined as a footing at least twice as long as it is wide.
5. This estimated post-construction settlement of the shallow footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are followed. A clear distance between footings of one footing size of the larger of the two footings should not produce overlapping stress distributions and would essentially behave as independent foundations.
6. The post-construction differential settlements may result from variances in subsurface conditions, loading conditions, and construction procedures. The settlement response of the footings will be more

Item	Description	Bleachers, Press Boxes, and Arched Entry

dependent upon the quality of construction than upon the response of the subgrade to the foundation loads.

7. The passive pressure along the exterior face of the footings should be neglected within the upper 3 feet due to surface effects and the presence of fill soils unless pavement is provided up to the edge of the structures. For interior footings, the allowable passive pressure may be used for the entire depth of the footing.
8. To be utilized on the base of the footings.
9. Structural uplift loads on the shallow footings may be resisted by the weight of the foundation plus the weight of any soil directly above the foundation. The ultimate uplift capacity of shallow footings should be reduced by an appropriate factor of safety to compute allowable uplift capacity.

Construction Considerations – Shallow Spread/Strip Footings (MPAC Building, Bleachers, Press Boxes, and Arched Entry)

Excavations for shallow footings should be performed with equipment capable of providing a relatively clean bearing area. The bottom 6 inches of the foundation excavations should be completed with a smooth-mouthed bucket or by hand labor. The excavations should be neatly excavated and properly formed. Debris in the bottom of the excavation should be removed prior to steel placement. Based on the groundwater observations obtained during our field program (refer to **Groundwater Conditions**), significant groundwater seepage is not anticipated for shallow footings at the recommended bearing depth. However, water should not be allowed to accumulate at the bottom of the foundation excavations. To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that concrete and steel be placed as soon as possible after the excavations are completed. Excavations should not be left open overnight. The bearing surface of the shallow footings should be evaluated immediately prior to placing concrete or a seal slab.

A thin seal slab of lean concrete (approximately 2 to 4 inches thick) should be placed at the bottom of the footing excavation to protect the bearing surface of the footings from disturbance and/or infiltration of ground/surface water if the footing cannot be poured within the same day of excavation.

Design Recommendations – Drilled Straight Shafts (MPAC Building)

The drilled straight shafts planned for the proposed MPAC building should be designed to resist both horizontal and vertical forces. Horizontal forces can be resisted by the passive pressure of soil acting on the vertical face of the drilled straight shafts. Vertical downward forces can be resisted by the allowable end bearing pressure of the soils at the bottom of the drilled straight shafts. Vertical uplift forces can be resisted by the

dead weight of the poles and its foundation. When foundation concrete is cast in direct contact with excavation sides, an allowable side friction value can also be used to resist vertical loads.

The allowable design criteria for utilization of drilled straight shafts as the foundation system for the proposed MPAC building are presented in the following table. The table includes the effective soil unit weights, shear strength parameters, allowable end bearing pressure, lateral passive pressure and side friction values. Furthermore, the lateral subgrade modulus values are provided for the cyclic and static loading conditions. Care should be exercised to utilize the appropriate loading condition in the analysis.

The design parameters presented in the following tables are applicable for the natural, undisturbed soils. The design parameters provided were calculated assuming groundwater is below 10 feet.

Long-term settlement of the drilled straight shaft foundation, designed and constructed in accordance with the recommendations presented in this report, should be about one inch or less.

Design Parameters for Drilled Straight Shaft Footings		
Below Existing Grade (feet) [1]	**Allowable Unit Skin Friction Resistance (psf)** [2]	**Allowable End Bearing Pressure (psf)** [3]
+7 to 0[4]	Disregard	
4 to 18	125	Disregard
18 to 30	475	8,000
30 to 50	625	10,000

1. Grade at the time of our field program.
2. The allowable side friction is based on a rectangular pressure distribution.
3. The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure. A minimum penetration of 2 feet or one-half a shaft diameter, whichever is greater, into the desired bearing strata should be achieved with a minimum of 4 feet of the selected bearing stratum beneath the shaft tip to use the recommended allowable end bearing pressure.
4. As previously discussed, we understand FFE is approximately 4 to 7 feet above existing grade.

LPILE Parameters for Drilled Straight Shaft Footings						
Soil Classification	**Below Existing Grade[1] (feet)**	**Effective Unit Weight (pcf)**	**Lateral Subgrade Modulus**	**Strain ε_{50} (in/in)**	**Undrained Shear Strength (psf)**	**Angle of Internal Friction (degree)**
Select fill	+7 to 0[3]	125	---	0.020	500	---
Lean Clay (CL)	0 to 10	125	---	0.020	500	---
Lean Clay (CL)	10 to 18	63[2]	---	0.020	500	---
Silty Sand (SM)	18 to 30	58[2]	60	---	---	30
Silty Sand (SM)	30 to 50	58[2]	60	---	---	32

1. Grade at the time of our field program.
2. Submerged unit weight.
3. As previously discussed, we understand FFE is approximately 4 to 7 feet above existing grade.

Design of drilled straight shafts should also include an evaluation of the structural capacity of the foundation element which may limit the allowable capacity.

There are numerous factors which contribute to the behavior of groups subjected to axial load. Several of these factors are foundation type, size and length, spacing, overall group size, loading conditions, installation procedures and soil type and strength. We recommend a minimum spacing of three diameters, center-to-center, for shafts or piles placed in groups beneath square or rectangular caps. However, for shafts or piles placed in a linear pattern beneath load bearing walls, a minimum spacing of two diameters, center-to-center, would generally be acceptable. Closer spacing than three diameters in groups or two diameters in rows could result in increased group settlement and a reduction of load-carrying capacity of individual foundation elements.

Settlement of a single, isolated shaft will depend on the elastic properties of the foundation, the applied load, and the interaction of the soil and foundation. Settlement is anticipated to be primarily elastic and will occur relatively soon as load is applied. Significant consolidation settlement due to applied load is not anticipated for the allowable capacities. Our experience indicates that a single, isolated foundation loaded to about one-half of its ultimate capacity will result in settlements of about one inch or less. Groups generally undergo more settlement than single, isolated foundation elements for the same applied load. Based on the above recommended spacing, we anticipate that settlement of a group will be on the order of one inch under working loads with differential settlement between foundations to be about one-half inch.

The drilled straight shaft foundations will provide resistance to lateral loads through the passive earth pressure acting on the side of the foundation. A detailed lateral load analysis of the proposed straight shaft footings was beyond the scope of this project. If requested, a

detailed lateral load analysis of the proposed drilled straight shaft foundations can be performed by Terracon. Lateral loads should not exceed the structural capacity of the individual drilled straight shaft.

Drilled straight shaft foundations will provide resistance to structural uplift loads through the mobilization of the skin friction acting at the interface of the shaft sidewall and the adjacent soils. The allowable skin friction values provided in the previous table may be used to calculate the uplift resistance for the shafts.

Construction Considerations – Drilled Straight Shafts

The drilling contractor should be experienced in the subsurface conditions observed at the site, and the excavations should be performed with equipment capable of providing a clean bearing area. The drilled straight-shaft foundation should be installed in general accordance with the procedures presented in "Drilled Shafts: Construction Procedures and LRFD Design Methods," by Brown, D.A., Turner, J.P., and Castelli, R.J., FHA Publication No. FHWA-NHI-10-016, 2010 and "Standard Specification for the Construction of Drilled Piers", ACI Publication No. 336.1-01, 2001.

The successful completion of the drilled straight shaft will depend to a large extent on the suitability of the equipment and the operator's skills. The operation sequence should be scheduled so that the shaft excavation can be completed, reinforcing steel placed, and the concrete poured in a continuous, rapid, and orderly manner to minimize the time the excavation is open. Concrete should be placed as soon as practical and in all instances should be placed within the same day in order to use the side friction values recommended in this report.

Based on the subsurface conditions observed, the installation of drilled straight shafts will likely require the use of the Slurry Displacement Method and/or temporary steel casing due to the presence of sandier/siltier zones and groundwater. If drilled shaft installation is attempted without utilizing Slurry Displacement Method or temporary casing, zones of sloughing soils and/or groundwater inflow may occur during construction. Therefore, we recommend that provisions be incorporated into the plans and specifications to utilize slurry or casing to control sloughing and/or groundwater seepage during shaft construction.

The need for casing or slurry will depend on the depth of the drilled shaft and the groundwater conditions at the time of construction. If casing is used and seepage persists, the water accumulating in the foundation excavation should be pumped out. The condition of the bearing surface should be evaluated immediately prior to placing concrete, if casing is used in lieu of slurry. If groundwater inflow is too severe to be controlled by the use of casing and pumping or significant sloughing of the sidewalls occurs, the slurry method of construction should be utilized to complete the foundation installation.

Where casing is used, removal of the casing should be performed with extreme care and under proper supervision to minimize mixing of the surrounding soil and water with the fresh concrete. Rapid withdrawal of the casing may develop a suction that could cause the soil and water to flow into the excavation. An insufficient head of concrete in the casing during withdrawal could also allow the water to intrude into the wet concrete. Under no circumstances should loose soil be placed in the annulus between the casing and the drilled shaft sidewalls. The casing must be removed in order to utilize the skin friction values previously provided.

During slurry displacement, the foundation excavation is filled with a slurry mixture. The level of slurry should be maintained above the groundwater level to maintain a positive head in the foundation excavation. Therefore, the slurry tends to seep out of the excavation, rather than the groundwater seeping into the open excavation. The slurry must be maintained in the foundation excavation until design termination depth is achieved and should be removed only as concreting proceeds. The properties of the slurry including the density, viscosity, and pH must be carefully controlled and should be in accordance with Item 416 of Texas Department of Transportation (TXDOT) Standard Specifications for Construction of Highways, Streets, and Bridges.

Slurry left in place for long periods of time will build up on the sides of the shaft causing a reduction in skin friction.

The following procedures and equipment are recommended for installation of drilled shafts by the Slurry Displacement Method:

- The bottom of the drilled straight shaft should be cleaned as well as practical just prior to concreting to remove cuttings.
- The concrete should be placed by means of a tremie with a one-way valve to prevent slurry from entering the pipe. The tremie should extend to the bottom of the drilled shaft to allow displacement of the slurry during concrete placement.
- During concrete placement, the end of the tremie should remain several feet within the concrete mass to reduce the entrapment of slurry. A tremie embedment of 5 to 10 feet is generally considered acceptable.
- The concrete should be relatively fluid to reduce the entrapment of slurry. We recommend that concrete with a slump of 6 to 8 inches be used.
- The upper few feet of concrete should be expunged from the shaft excavation if found to be contaminated with slurry or soil.

A surface casing may be required in addition to the slurry for shaft installation at this site if sloughing of near surface soils occurs. Where casing is used, removal of the casing should be performed with extreme care as previously discussed in this section.

Production shaft installation should be observed by a qualified technician experienced in drilled shaft installation techniques. At a minimum, the technician should observe shaft excavation, note any unusual installation occurrences, observe slurry properties and/or casing installation and removal, observe concrete placement and generally evaluate if shaft installation is being performed in accordance with project specifications.

Design Recommendations – Drilled-and-Underreamed Footings (Bleachers, Press Box, and Arched Entry)

Item	Description
Minimum Embedment Depth [1]	8 feet below existing grade (grade at the time of our field program)
Allowable Bearing Pressures [2]	Net dead plus sustained live load – 4,000 psf Net total load – 6,000 psf
Maximum Underream-to-Shaft Diameter Ratio	3:1
Approximate Post-Construction Settlement [3]	One inch or less
Estimated Differential Settlement [4]	Approximately ½ of post-construction settlement
Allowable Passive Pressure [5]	1,000 psf
Uplift Resistance [6]	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

1. The footings should bear within the undisturbed native clay soils.
2. Whichever condition yields a larger bearing area.
3. This estimated post-construction settlement of the footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are followed. A clear distance between the footings of one underream diameter of the larger footing should be provided between the underreams to develop the recommended bearing pressures and to control settlements. If a clearance of one diameter cannot be maintained in every case, the above bearing capacities should be reduced by 20 percent for a clearance between one half and one underream diameters. Underreams closer than a clearance of one half of an underream diameter are not recommended.
4. The differential settlement will result from variances in subsurface conditions, loading conditions and construction procedures, such as cleanliness of the bearing area or flowing water in the shaft.
5. For footings placed against an undisturbed vertical face of the in-situ soils. Lateral resistance of the drilled-and-underreamed footings is primarily developed by passive resistance of the soils against the side of the footing. Due to surface effects, the lateral resistance of the upper 3 feet of the soils at the surface for exterior footings should be neglected unless area paving is provided up to the edge of the structures.

Item	Description
6.	Structural uplift loads on the drilled-and underreamed footings will be resisted by the dead weight of the footings and supported structure plus the weight of a soil wedge above the footing. The soil wedge can be assumed to extend upward from the bottom of the underream at a slope of 4 vertical to 1 horizontal.

Construction Considerations – Drilled-and-Underreamed Footings

Drilled excavations to a depth of 8 feet below existing grade will be necessary for installation of drilled-and-underreamed footings for the proposed structures planned at this site. The excavations should be performed with equipment capable of providing a relatively clean bearing area. The presence of secondary structures such as ferrous stains and nodules, etc., can cause sloughing during footing excavation. Thus, the drilling contractor should have casing available in the event that sloughing causes improperly formed shafts.

Based on our groundwater observations (refer to **Groundwater Conditions**), groundwater is not expected to be a major concern during construction at the recommended bearing depth. However, depending on climatic conditions, groundwater levels may vary from the levels observed during our field program. Water must not be allowed to accumulate in the bottom of the footing excavations. The contractor should be prepared to remove water from the drilled footings, if necessary. To reduce the potential for water seepage into the footing excavation and to minimize disturbance to the bearing area, we recommend that concrete and steel be placed as soon as possible after footing excavations are completed. Preferably, footing excavations should be backfilled with concrete within about 2 to 4 hours of completion of the drilling and in no case should an excavation be left open overnight. The concrete placed in the excavations should have a 6-inch slump with a plus or minus one inch tolerance. The bottom of each footing excavation should be free of all loose materials and/or water, and the bearing surface should be evaluated immediately prior to placing concrete.

Based on the available field and laboratory data, the underreams constructed as described in this report should remain stable for a short period of time. However, if underreams are marginally stable due to water seepage and/or the presence of sloughing soils, successful construction of underreamed footings may be possible by performing the sequence of construction without interruption, that is, each footing drilled, underreamed, and backfilled with concrete in one continuous operation. The contractor must coordinate the operation very closely to have concrete on site at the time each footing is drilled and underreamed so that no shaft or underream is drilled without concrete standing by, ready to be placed. Additional measures to reduce the potential for caving of the underream would be to limit the underream-to-shaft diameter ratio to 2.5:1 or 2:1 or to install straight shaft footings in isolated problem areas. If straight-shaft footings are planned at the site, Terracon should be contacted for additional recommendations.

Grade Beams – Drilled-and-Underreamed Footings

Grade beams associated with the drilled-and-underreamed footings and a grade-supported floor slab should be designed to span between the footings without subgrade support. We understand the grade beams are planned to be constructed without a void space. However, due to the underlying clay soils, nominal upward movement of the grade beams may occur during moisture variations of the subgrade.

Backfill against the outside face of the grade beams should consist of select fill used to prepare the building pad. The select fill should be uniformly compacted to at least 95 percent of the Standard Effort (ASTM D698) maximum dry density at a moisture content within 2 percent of optimum moisture content.

Foundation Construction Monitoring

The performance of the foundation systems for the proposed structures will be highly dependent upon the quality of construction. Thus, we recommend that fill pad compaction and foundation installation be observed full time by an experienced Terracon soil technician under the direction of our geotechnical engineer. During foundation installation, the base of the foundation excavations should be observed to evaluate the condition of the subgrade. We would be pleased to develop a plan for compaction and foundation installation observation to be incorporated in the overall quality control program.

Floor Slab

As stated previously, finished floor elevation is planned to be 200 feet, which is approximately 4 to 7 feet above existing grade. If the grading is planned to be altered from what has been previously described, Terracon should be notified to review and/or modify our recommendations given in this subsection.

Due to the amount of the fill observed at the proposed bleachers and press box areas, we recommend that the fill soils be over-excavated and completely removed within the proposed structure areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed structure areas.

The near surface soils observed within the area of the proposed structures generally exhibit a low to medium expansion potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils at this site exhibit a Potential Vertical Rise (PVR) of up to approximately one inch.

To provide uniform support to the floor slab/slabs, we recommend that a minimum 12 inches of properly placed and compacted select fill material be constructed immediately beneath the floor slab/slabs. The select fill pad should extend a minimum of 3 feet beyond the edge of the proposed structure areas. The final exterior grade adjacent to the structures should be sloped to promote effective drainage away from the structures.

Select fill should be utilized for all grade adjustments within the proposed structure areas. The subgrade and select fill soils should be prepared as outlined in the **Earthwork** section of this report, which contains material and placement requirements for select fill, as well as other subgrade preparation recommendations.

Pavements

Once the subgrade is properly prepared, a rigid pavement system may be considered for this project. Detailed traffic loads and frequencies were not available. However, we anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with garbage trucks, buses and large multi-axle delivery trucks from time-to-time in driveway areas. We anticipate fire lane traffic will consist of light passenger car traffic and a 75,000 pound truck one or two times a year.

Tabulated in the following table are the assumed traffic frequencies and loads used to design pavement sections for this project. When actual traffic conditions have been determined Terracon should be contacted to review the information to consider a need for revision of the pavement designs and related recommendations.

Pavement Area	Traffic Design Index [1]	Description
Automobile Parking Areas	DI-1	Light traffic (Few vehicles heavier than passenger cars, no regular use by heavily loaded two axle trucks/buses.) (EAL [2] < 6)
Driveways (Light Duty)	DI-2	Medium to light traffic (Similar to DI-1 including not over 50 loaded two axle trucks/buses or lightly loaded larger vehicles per day. No regular use by heavily loaded trucks with three or more axles.) (EAL = 6-20)
Driveways and Truck Traffic Areas (Medium Duty)	DI-3	Medium traffic (Including not over 300 heavily loaded two axle trucks/buses plus lightly loaded trucks with three or more axles and no more than 30 heavily loaded trucks with more than three axles per day.) (EAL = 21-75)

Pavement Area	Traffic Design Index [1]	Description

1. Based on NSSGA traffic design indices.
2. Equivalent daily 18-kip single-axle load applications.

The top 6 inches of the finished subgrade soils directly beneath the pavements should be chemically treated with a mixture of lime-flyash. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. These 6 inches of treatment is a required part of the pavement design and is not a part of the site and subgrade preparation for wet/soft subgrade conditions.

Listed below are pavement component thicknesses, which may be used as a guide for pavement systems at the site for the traffic classifications stated herein. These systems were derived based on general characterization of the subgrade. Specific testing (such as CBR's, resilient modulus tests, etc.) was not performed for this project to evaluate the support characteristics of the subgrade.

Rigid Pavement System			
Component	Material Thickness, Inches		
	DI-1	DI-2	DI-3
Reinforced concrete	5.0	6.0	7.0
Treated subgrade	6.0	6.0	6.0

Waste dumpster areas should be constructed of at least 7 inches of reinforced concrete pavement. The concrete pad areas should be designed so that the vehicle wheels of the collection truck are supported on the concrete while the dumpster is being lifted to support the large wheel loading imposed during waste collection.

Presented below are our recommended material requirements for the various pavement sections.

Reinforced Concrete Pavement – The materials and properties of reinforced concrete pavement should meet applicable requirements in the ACI Manual of Concrete Practice. The portland cement concrete mix should have a minimum 28-day compressive strength of 3,500 psi.

If river gravel is planned to be utilized in the portland cement concrete mix, Terracon should be contacted for additional services. The presence of river gravel in the portland cement concrete mix can result in excessive cracking and distress to the concrete pavement as a result of differing thermal expansion properties between the river gravel

and cement paste. Special care should be taken in developing the project's portland cement concrete mix design, joint layout, and placement to help reduce the potential for excessive cracking and distress if river gravel is planned to be utilized for the project.

Reinforcing Steel – ACI recommendations indicate that distributed steel reinforcement is not necessary when the pavement is properly jointed to form short panel lengths that will help reduce intermediate cracking. Provided the concrete pavement is designed and constructed as stated herein, the installation of reinforcing steel is optional and should be evaluated by the design team. Proper layout and installation of the joints within the pavement is critical to help control intermediate cracking.

If reinforcing steel is planned to be utilized in the concrete pavement by the design team, the following amount of reinforcing steel should be used as a guideline:

- DI-1: #3 bars spaced at 18 inches or #4 bars spaced at 24 inches on centers in both directions.
- DI-2: #3 bars spaced at 12 inches or #4 bars spaced at 18 inches on centers in both directions.
- DI-3: #4 bars spaced at 18 inches on centers in both directions.

Control Joint Spacing – ACI recommendations indicate that control joints should be spaced at a maximum spacing of 30 times the thickness of the pavement for unreinforced parking lot pavements. Furthermore, ACI recommends a maximum control joint spacing of 12.5 feet for 5-inch pavements and a maximum control joint spacing of 15 feet for 6-inch or thicker pavements. Sawcut control joints should be cut within 4 to 12 hours of concrete placement to help control the formation of plastic shrinkage cracks as the concrete cures. The depth of the joint should be at least one-quarter of the slab depth when using a conventional saw or one inch when using early entry saws. The width of the cut should be in accordance with the joint sealant manufacturer recommendations.

Expansion Joint Spacing – ACI recommendations indicate that regularly spaced expansion joints may be deleted from concrete pavements. Therefore, the installation of expansion joints is optional and should be evaluated by the design team.

Construction Joints – When concrete is planned to be placed at different times, we recommend the use of a construction joint between paving areas. The construction joint should consist of a butt joint (not a keyway joint).

Concrete Curing Compound – A concrete curing compound, such as a Type 2 membrane curing compound conforming to TxDOT DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants" or equivalent, should be applied to the concrete surface immediately after placement of the concrete in accordance with TxDOT 2014 Standard Specifications Item 360.

Dowels at Expansion/Construction Joints – The smooth dowels at expansion/construction joints should be spaced at 12-inch centers and consist of the following:

- DI-1: 5/8-inch diameter, 12-inches long with 5-inch embedment.
- DI-2: 3/4-inch diameter, 14-inches long with 6-inch embedment.
- DI-3: 7/8-inch diameter, 14-inches long with 6-inch embedment.

One end of the dowels should either be greased or sleeved to allow for lateral movement to occur.

Lime-Flyash Treated Subgrade – The on-site soils should be treated with lime-flyash in accordance with TxDOT 2014 Standard Specifications Item 265. Based on the classification test results, we recommend about 2 to 3 percent lime and 7 to 8 percent flyash by dry weight be used for estimating and planning. The percentages are given as application by dry weight and are typically equivalent to about 10 to 15 pounds of lime and 35 to 40 pounds of flyash per square yard per 6-inch depth. Lime-flyash is also available pre-mixed, typically in percentages of 20 to 30 percent lime and 70 to 80 percent flyash. These pre-mixed products may be used if preferred at a rate of 50 pounds per square yard per 6-inch depth. The actual quantity of lime-flyash should be determined at the time of construction based on laboratory testing conducted using bulk samples of the subgrade soils. The subgrade should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density at a moisture content within 2 percent of the optimum moisture content.

Preferably, traffic should be kept off the treated subgrade for 7 days to facilitate curing of the soil-chemical mixture. In addition, the subgrade is not suitable for heavy construction traffic prior to paving.

Post-construction subgrade movements and some cracking of pavements are not uncommon for clay subgrade conditions such as those observed at this site. Although chemical treatment will help to reduce such movement/cracking, this movement/cracking cannot be feasibly eliminated.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. The following recommendations should be implemented to help promote long-term pavement performance:

- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent;

- Install joint sealant and seal cracks immediately;
- Extend curbs into the treated subgrade for a depth of at least 4 inches to help reduce moisture migration into the subgrade soils beneath the pavement section; and
- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.

Preventative maintenance should be planned and provided for the pavements at this site. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and consist of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Prior to implementing any maintenance, additional engineering observations are recommended to determine the type and extent of preventative maintenance.

General Comments

Our work is conducted with the understanding of the project as described in the proposal and incorporates collaboration with the design team as we completed our services to verify assumptions. Revision of our understanding to reflect actual conditions important to our work was based on these verifications and it is reflected in this report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the geotechnical conditions in the area, the data obtained from our site exploration and from our understanding of the project. Variations will occur between exploration point locations, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner

is concerned about the potential for such contamination or pollution, other services should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes only. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing.

Figures

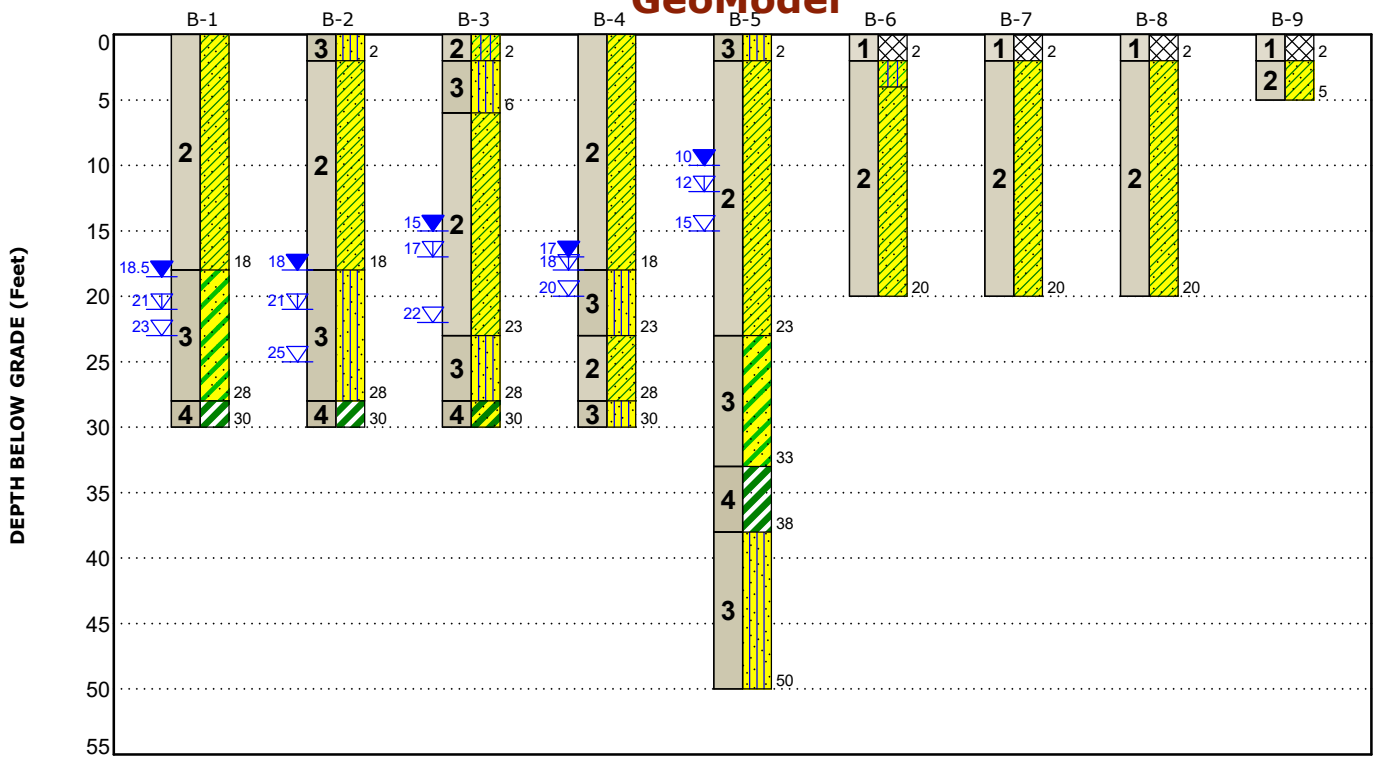
Contents:

GeoModel

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Fill: Sandy Lean Clay and Poorly Graded Sand with Silt**	dark gray, with scatttered gravel
2	**Sandy Lean Clay and Sandy Silty Clay**	dark gray, tan, reddish brown, and light gray, very soft to hard, with ferrous stains and nodules
3	**Silty Sand and Clayey Sand**	light gray, reddish brown, dark gray, and tan, very loose to very dense, with clay pockets
4	**Fat Clay and Sandy Fat Clay**	reddish brown and light gray, very stiff to hard, with slickensides

Legend

- Sandy Lean Clay
- Clayey Sand
- Fat Clay
- Silty Sand
- Sandy Silty Clay
- Sandy Fat Clay
- Fill

▽ First Water Observation
▽ Second Water Observation
▼ Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet) [1]	Location
4 (B-1 through B-4)	30	MPAC building area
1 (B-5)	50	
2 (B-6 and B-7)	20	Bleachers and press box areas
1 (B-8)	20	Entry gate area
1 (B-9)	5	Concrete driveway area

1. Below existing grade at the time of our field program.

Boring Layout and Elevations: We used handheld Global Positioning System (GPS) equipment to locate the approximate latitude and longitude of the borings with an accuracy of +/-25 feet. The boring depths were measured from the existing ground surface at the time of our field activities.

Subsurface Exploration Procedures: We advanced soil borings with an ATV mounted drill rig using solid stem continuous flight augers. Samples were obtained at 2-foot intervals in the upper 12 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was typically performed using open-tube and/or split-barrel sampling procedures.

Cohesive soil samples were generally recovered using open-tube samplers. Hand penetrometer tests were performed on samples of cohesive soils in the field to serve as a general measure of consistency.

Granular soils and soils for which good quality open-tube samples could not be recovered were sampled by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows (N) required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated six inches. This blow count or SPT "N" value is used to evaluate the stratum. A conventional safety hammer operated with a cathead and rope was used in advancing the split-spoon sampler.

The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during drilling and sampling.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information.

Field logs include visual classifications of materials observed during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent an interpretation of the field logs by a geotechnical engineer and include modifications based on laboratory observation and tests on select samples.

Property Disturbance: We backfilled the borings with auger cuttings upon completion. Excess auger cuttings were dispersed in the general vicinity of the boring. Our services do not include repair of the site beyond backfilling our borings. Because backfill material often settles below the surface after a period, we recommend borings be periodically checked and backfilled, if necessary. We can provide this service for additional fees, at your request.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D1140 Standard Test Methods for Amount of Materials in Soils Finer than the No. 200 Sieve
- ASTM D7263 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil

The laboratory testing program included observation of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System (USCS).

Samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless we are notified otherwise.

Site Location and Exploration Plans

Contents:

Site Location
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

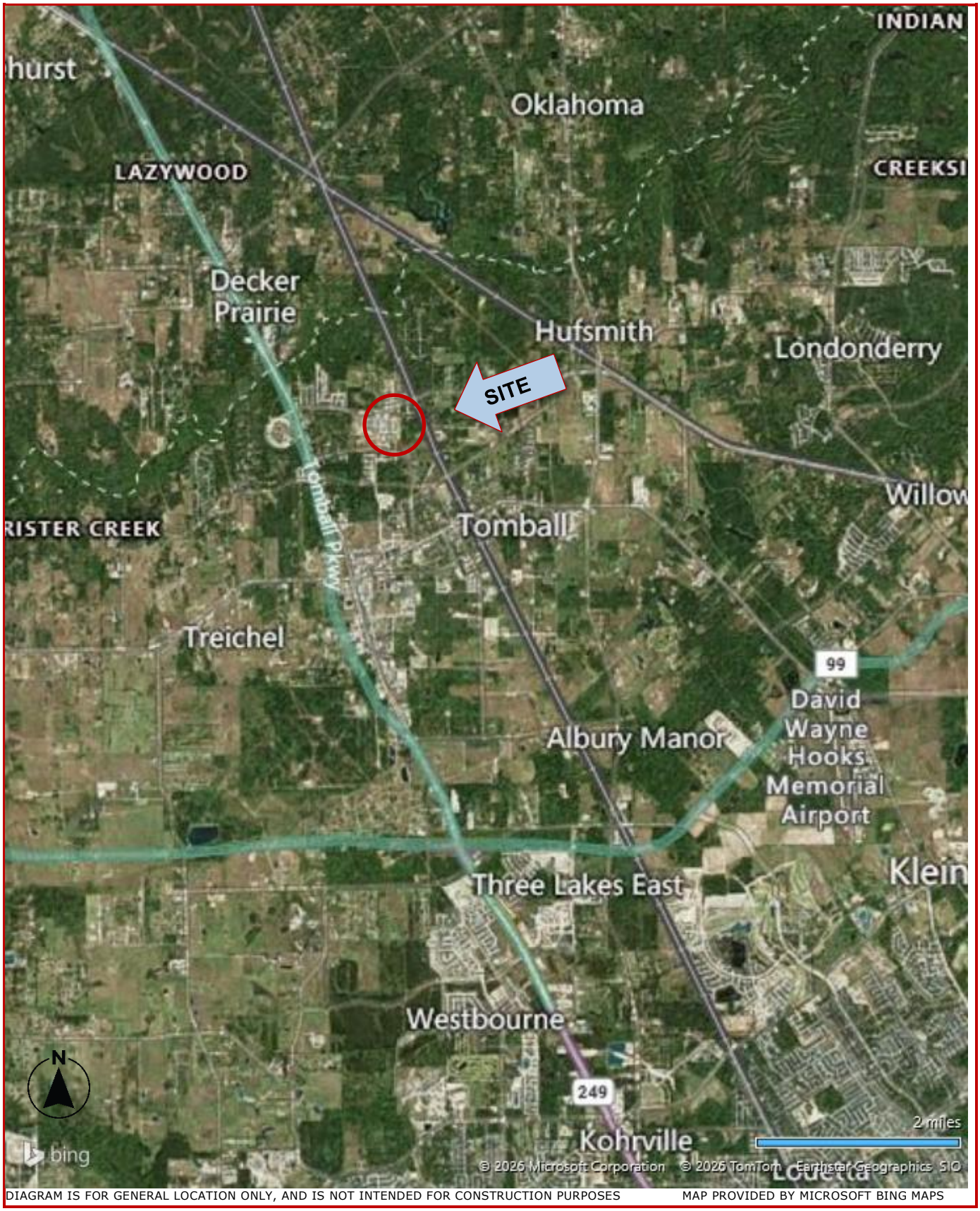


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

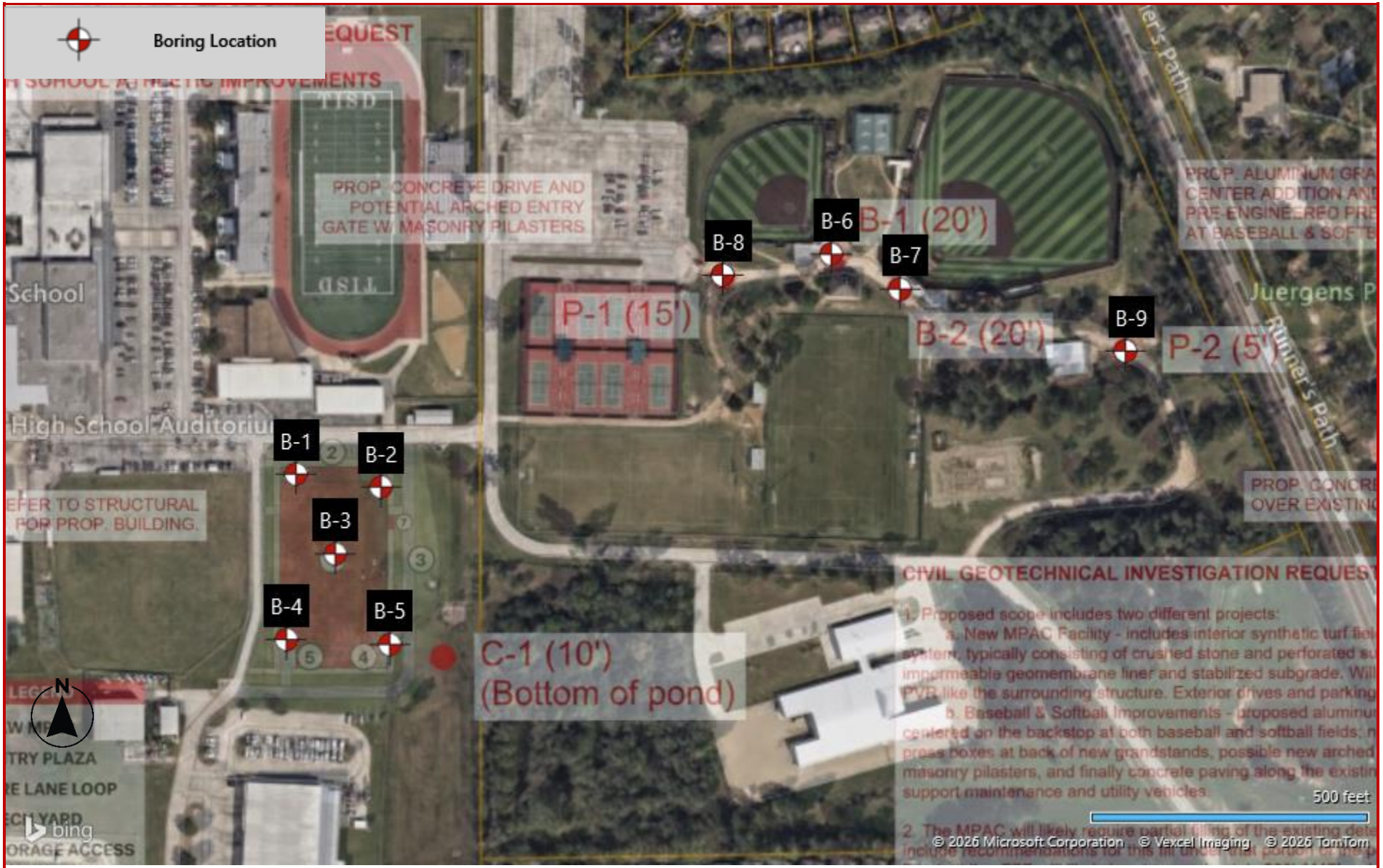


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-9)

Note: All attachments are one page unless noted above.

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 30.1103° Longitude: -95.6259°

Model Layer	Graphic Log	Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
2			**SANDY LEAN CLAY (CL)**, dark gray, soft to very stiff, with ferrous nodules			2.5 (HP)				11.7		22-11-11	
			- tan and reddish brown, with ferrous stains 2 to 18 feet			1.5 (HP)	UC	0.62	8.1	13.7	120		52.1
		5				0.5 (HP)				14.5		28-12-16	
						0.75 (HP)							
						0.5 (HP)							
		10				1.5 (HP)	UC	0.97	7.5	15.8	125		
						3.5 (HP)							
		15											
						12-22-27 N=49				15.1			33.3
3		20											
						4.5 (HP)							
		25											
4			18.0 **CLAYEY SAND (SC)**, light gray and reddish brown, medium dense to dense 28.0			8-12-14 N=26							
			FAT CLAY (CH), reddish brown and light gray, very stiff 30.0										
		30	***Boring Terminated at 30 Feet***										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
03-24-2026

Boring Completed
03-24-2026

Notes

Advancement Method
Dry augered to 23 feet; wet rotary thereafter.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 30.1102° Longitude: -95.6255°

Model Layer	Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
3		2.0	**SILTY SAND (SM)**, dark gray, medium dense, with clay pockets				3.0 (HP)							
2			**SANDY LEAN CLAY (CL)**, tan and reddish brown, soft to hard, with ferrous stains and nodules				1.5 (HP)				15.2		23-12-11	
			- light gray 4 to 18 feet	5			0.5 (HP)	UC	0.45	14.3	17.7	114		
							0.5 (HP)				17.2		29-13-16	
				10			1.0 (HP)							
							1.0 (HP)							
							4.5 (HP)	UC	4.17	13.6	18.0	110		
		18.0		15	▼									
3			**SILTY SAND (SM)**, light gray and tan, very dense, with clay pockets	20	▽		18-30-38 N=68							
				25	▽		15-28-33 N=61				14.8			28.6
		28.0												
4		30.0	**FAT CLAY (CH)**, reddish brown, very stiff, with slickensides				4.5 (HP)							
			Boring Terminated at 30 Feet	30										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- ▽ While drilling
- ▽ After 5 minutes
- ▼ After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
03-20-2026

Boring Completed
03-20-2026

Notes

Advancement Method
Dry augered to 25 feet; wet rotary thereafter.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 30.1099° Longitude: -95.6557°

Model Layer	Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
2		2.0	**SANDY SILTY CLAY (CL-ML)**, dark gray, medium stiff				4.5 (HP)	UC	0.64	4	10.4	100	19-13-6	
3		6.0	**SILTY SAND (SM)**, dark gray, very loose				1-1-2 N=3							
				5			1-2-1 N=3				12.0		NP	
2		23.0	**SANDY LEAN CLAY (CL)**, tan and light gray, soft to stiff, with ferrous stains and nodules				0.75 (HP)							
							0.5 (HP)							
				10			1.75 (HP)	UC	0.82	6.5	15.9	117		
			- reddish brown 13 to 23 feet				2.0 (HP)							
				15										
							4.5 (HP)							
				20										
3		28.0	**SILTY SAND (SM)**, light gray and reddish brown, very dense				15-37-50 N=87				12.7			28.2
				25										
4		30.0	**SANDY FAT CLAY (CH)**, light gray and reddish brown, hard				9-16-25 N=41							
				30										
			Boring Terminated at 30 Feet											

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
03-20-2026

Boring Completed
03-20-2026

Notes

Advancement Method
Dry augered to 22 feet; wet rotary thereafter.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 30.1094° Longitude: -95.6260°

Model Layer	Graphic Log	Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
2			**SANDY LEAN CLAY (CL)**, dark gray, very soft to stiff, with ferrous stains and nodules			2.0 (HP)							
						1.5 (HP)				14.0		28-12-16	
			- light gray and reddish brown 4 to 18 feet			1.25 (HP)	UC	0.92	7.2	14.7	120		
		5				1.0 (HP)				16.5		31-13-18	
						1.25 (HP)							
		10				0.25 (HP)							
						2.0 (HP)	UC	0.63	5.9	17.3	111		
		15											
3			18.0 **SILTY SAND (SM)**, light gray and reddish brown, very dense, with clay pockets			16-30-35 N=65							
		20	23.0										
2			**SANDY LEAN CLAY (CL)**, light gray and reddish brown, very stiff			4.5 (HP)							
		25	28.0										
3			**SILTY SAND (SM)**, light gray and reddish brown, very dense, with clay pockets			20-50/5"							
		30	30.0										
			Boring Terminated at 30 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
03-23-2026

Boring Completed
03-23-2026

Notes

Advancement Method
Dry augered to 20 feet; wet rotary thereafter.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 30.1094° Longitude: -95.6256°

Model Layer	Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
3		2.0	**SILTY SAND (SM)**, dark gray, loose				1.0 (HP)				6.9		NP	
2		23.0	**SANDY LEAN CLAY (CL)**, dark gray, soft to very stiff - light gray and reddish brown, with ferrous stains 4 to 23 feet - with ferrous nodules 8 to 18 feet	5			1.5 (HP)	UC	0.43	3.8	14.6	113		
							1.5 (HP)				14.9		22-11-11	
							0.5 (HP)							
							0.75 (HP)	UC	0.37	7	16.9	117		
				10	▼		1.75 (HP)							
					▽									
					▽		3.0 (HP)							
				15										
							4.5 (HP)							
				20										
3		33.0	**CLAYEY SAND (SC)**, light gray and reddish brown, medium dense to very dense				15-32-38 N=70							
				25										
							4.5 (HP)				13.4		28-14-14	28.2
				30										
4		38.0	**FAT CLAY (CH)**, reddish brown, stiff				2.0 (HP)	UU	1.77	15	20.4	108		
				35										
3		50.0	**SILTY SAND (SM)**, reddish brown, dense to very dense				10-18-22 N=40							
				40										
							7-14-28 N=42							
				45										
							12-22-35 N=57							
			Boring Terminated at 50 Feet	50										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- While drilling
- After 5 minutes
- After 15 minutes

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Logged by
H. Zamudio

Boring Started
03-23-2026

Boring Completed
03-23-2026

Notes

Advancement Method
Dry augered to 15 feet; wet rotary thereafter.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-6

Location: See Exploration Plan

Latitude: 30.1113° Longitude: -95.6229°

Model Layer	Graphic Log	Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
1		2.0	**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, dark gray, with scattered gravel			17-10-15 N=25							
2		4.0	**SANDY SILTY CLAY (CL)**, dark gray, very stiff			2.25 (HP)				12.3		21-14-7	
		5	**SANDY LEAN CLAY (CL)**, light gray and reddish brown, stiff to very stiff, with ferrous stains			2.5 (HP)	UC	1.79	5.3	15.1	121		
						2.5 (HP)				14.9		46-17-29	
						3.75 (HP)							
		10				4.5 (HP)	UC	2.63	4.6	14.6	123		
						4.5 (HP)							
		15											
		20	20.0			4.5 (HP)							
			Boring Terminated at 20 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
No free water observed

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Notes

Advancement Method
Dry augered to 20 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio

Boring Started
03-24-2026

Boring Completed
03-24-2026

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-7

Location: See Exploration Plan

Latitude: 30.1112° Longitude: -95.6225°

Model Layer	Graphic Log	Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
1		0	**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, dark gray, with scattered gravel			4-6-18 N=24				5.8		NP	
		2.0				2.0 (HP)							
2			**SANDY LEAN CLAY (CL)**, light gray and reddish brown, medium stiff to very stiff, with ferrous stains - with ferrous nodules 2 to 8 feet			1.0 (HP)	UC	0.60	5	17.5	108	41-16-25	
		5				1.0 (HP)							
						2.0 (HP)	UC	1.88	5.3	16.5	112		
		10				2.0 (HP)							
						4.5 (HP)							
		15											
		20				3.0 (HP)							
		20.0	***Boring Terminated at 20 Feet***										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
No free water observed

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Notes

Advancement Method
Dry augered to 20 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio

Boring Started
03-24-2026

Boring Completed
03-24-2026

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-8

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1112° Longitude: -95.6235° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
1		**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, dark gray, with scattered gravel 2.0				4-17-15 N=32							
2		**SANDY LEAN CLAY (CL)**, dark gray, stiff to very stiff - with ferrous stains and nodules 2 to 13 feet - light gray and reddish brown below 2 feet				1.25 (HP)				13.9		29-14-15	
			5			1.5 (HP)	UC	1.53	3.7	14.4	115		
						3.0 (HP)				15.4		46-16-30	
						4.5 (HP)							
			10			4.5 (HP)	UC	3.72	6.2	17.7	109		
						4.5 (HP)							
			15										
		20.0				4.5 (HP)							
		Boring Terminated at 20 Feet	20										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
No free water observed

Drill Rig
ATV

Hammer Type
Rope and Cathead

Driller
DAS

Notes

Advancement Method
Dry augered to 20 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio

Boring Started
03-24-2026

Boring Completed
03-24-2026

Tomball High School Athletic Improvements
30330 Quinn Rd | Tomball, Texas
Terracon Project No. 92265050

Terracon
11555 Clay Rd, Ste 100
Houston, TX

Boring Log No. B-9

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 30.1109° Longitude: -95.6212° Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Strength Test: Test Type	Strength Test: Compressive Strength (tsf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits: LL-PL-PI	Percent Fines
1		**FILL - SANDY LEAN CLAY (CL)**, dark gray, with scattered gravel 2.0				1.5 (HP)				13.1		26-14-12	
2		**SANDY LEAN CLAY (CL)**, dark gray and reddish brown, stiff, with ferrous nodules 5.0 - tan below 4 feet				1.75 (HP)							
		Boring Terminated at 5 Feet	5			1.75 (HP)							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).
See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
No free water observed

Drill Rig
ATV

Driller
DAS

Notes

Advancement Method
Dry augered to 5 feet.

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Logged by
H. Zamudio

Boring Started
03-24-2026

Boring Completed
03-24-2026

Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

Terracon
11555 Clay Rd, Ste 100
Houston, TX

General Notes

Sampling	Water Level	Field Tests
Shelby Tube Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils
(More than 50% retained on No. 200 sieve.)
Density determined by Standard Penetration Resistance

Relative Density	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 50
Very Dense	> 50

Consistency of Fine-Grained Soils
(50% or more passing the No. 200 sieve.)
Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Soft	less than 0.25	0 - 1
Soft	0.25 to 0.50	2 - 4
Medium Stiff	0.50 to 1.00	5 - 8
Stiff	1.00 to 2.00	9 - 15
Very Stiff	2.00 to 4.00	16 - 30
Hard	> 4.00	> 30

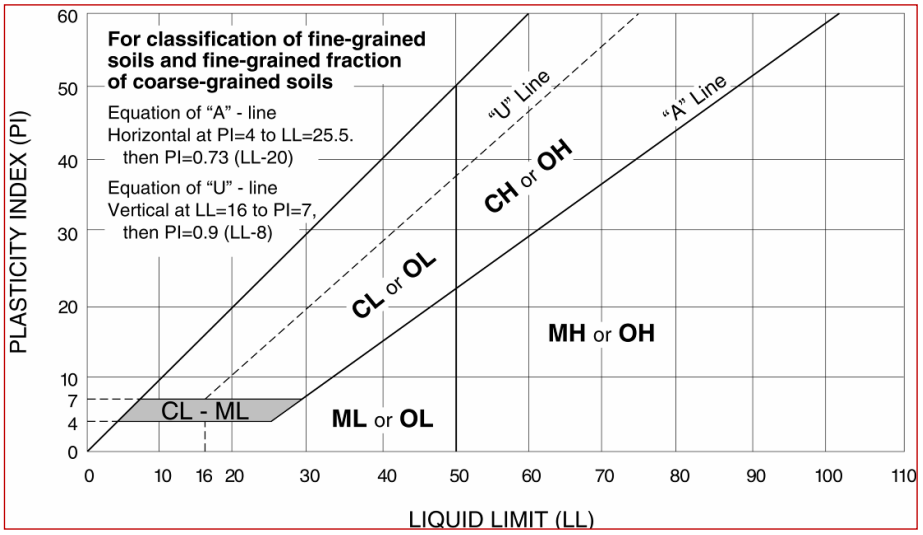
Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 4 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



SECTION 02 41 13.23 - ABANDONMENT OF EXISTING UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

A. Abandon water lines, storm and sanitary sewers, manholes, and associated appurtenances as indicated on the Plans in accordance with the methods outlined herein.

1.2 PAYMENT

A. Payment will be made if an item is provided for such on the bid form; otherwise, include cost of work in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Specific products are not required. Reference other applicable sections of the specifications for material required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate all work so that existing utilities are operable until new utilities are complete and in place. Keep any service interruptions to a minimum.

3.2 WATER LINE ABANDONMENT

A. Remove at least one joint of existing pipe where crossing or tying-in with new water lines. Plug both ends of abandoned line with an appropriate manufactured fitting (cap or plug) or fill end of line with 3000 psi concrete. Backfill as per SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

3.3 SEWER ABANDONMENT

A. Unless noted on drawings to be removed, abandon sewers 12 inches in diameter and smaller by filling with a liquid concrete slurry composed of a 3 sack per cubic yard mix using pea gravel (1-1/2 inch and smaller aggregate) or drilling mud. Limit length of application to individual sections between manholes. Construct a temporary dam in downstream manholes above top of pipe. Pour slurry or mud in upstream manhole or in riser pipe attached to upstream end of sewer. Fill line till slurry or mud rises above top of pipe on both ends.

B. Sewers between 12” – 36” in diameter shall be abandoned in accordance with either 3.3.A or 3.3.C.

C. Unless noted on drawings to be removed, abandon sewers 36 inches in diameter and larger by breaking in top of pipe and backfilling. Excavate and expose top half of existing sewer. Using appropriate equipment, cave-in the top half of pipe; as a minimum, the upper 120-degree section of pipe must be broken in. Fill open pipe with backfill material and compact to top of existing pipe.

Backfill to grade in accordance with SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

3.4 MANHOLE ABANDONMENT

A. After abandoning sewer lines in the appropriate manner, fill manholes to be abandoned with bank sand. Excavate around top of manhole and remove manway (reducer) section of manhole. Fill manhole with bank sand in 12-inch compacted lifts to top of manhole barrel. Backfill to finished grade in accordance with SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES.

END OF SECTION 02 41 13.23

SECTION 03 05 80 - UNDER-SLAB VAPOR BARRIER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Products Supplied Under This Section
   1. Vapor Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.

B. Related Sections
   1. Section 03 30 00 Cast-in-place Structural Concrete
   2. Section 01 45 23 Structural Testing and Inspection

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Barriers Used in Contact with Soil or Granular Fill Under Concrete Slabs
   2. ASTM E 154-88 (2005) Standard Test Methods for Water Vapor Barriers Used in Contact with Earth Under Concrete Slabs
   3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
   4. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Barriers Used in Contact with Earth or Granular Fill Under Concrete Slabs

B. American Concrete Institute (ACI)
   1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.4 SUBMITTALS

A. Quality Control / Assurance
   1. Full set of test results as per paragraph 8.3 of ASTM E 1745.
   2. Manufacturer’s samples, literature
   3. Manufacturer’s installation instructions for placement, seaming and pipe boot installation.

1.5 SUBSTITUTIONS

A. Product Review
   1. Request must be made 14 days prior to bid date to allow time for proper review. Reviews will be at contractor’s expense.
   2. Independent laboratory test results showing compliance with ASTM E 1745 Class A, a permeance less than 0.01 Perms (grains/(ft2 *hr * in. Hg) before and after the mandatory

conditioning tests ASTM E 154 Sections 8,11,12, and 13. (Woven, and recycled plastics are not permitted

3. Incomplete substitutions will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Vapor Barrier (Performance based specification). When the specifications of different sections conflict, the contractor shall perform to the most restrictive provision. Vapor Barrier membrane must have the following properties.

1. Permeance as tested after mandatory conditioning (ASTM E 154 sections 8,11,12,13) less than 0.01 Perms [grains/(ft2 *hr. * in. Hg)]
2. Other performance criteria
   a. Strength: ASTM E 1745 Class A
   b. Thickness: 15 mils minimum

2.2 ACCESSORIES

A. Seam Tape

1. Tape must have the following qualities:
   a. Water Vapor Transmission Rate ASTM E 96, 0.3 perms or lower
2. Seam Tape
   a. Manufacturer’s standard seam tape.
   b. Stego Crete Claw (for slabs on void boxes).

B. Vapor Proofing Mastic

1. Mastic must have the following qualities:
   a. Water Vapor Transmission Rate ASTM E 96 0.3 perms or lower

C. Pipe Boots

1. Construct pipe boots from Vapor Barrier material, pressure sensitive tape and/or mastic per manufacturer’s instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ensure that subsoil is approved by architect or geotechnical firm

1. Level and tamp or roll aggregate, sand, or tamped earth base.

3.2 INSTALLATION

A. Install Vapor Barrier:

1. Installation shall be in accordance with manufacturer’s written instructions and ASTM E 1643-09.
   a. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour.
   b. Lap Vapor Barrier over footings or seal to foundation walls.

c. Overlap joints 6 inches and seal with manufacturer's tape.
d. Seal all penetrations (including pipes) per manufacturer's instructions.
e. No penetration of the Vapor Barrier is allowed except for reinforcing steel and permanent utilities.
f. Repair damaged areas by cutting patches of Vapor Barrier, overlapping damaged area 6 inches, and taping all four sides with tape.

END OF SECTION 03 05 80

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete formwork, for the following:
   1. Footings and/or piers.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

B. Related Sections:
   1. Section 01 45 23 “Testing and Inspection Services”.
   2. Section 03 33 00 "Architectural Concrete".
   3. Section 03 30 00 “Cast In Place Concrete”.
   4. Section 03 20 00 “Concrete Reinforcing”.
   5. Section 03 47 13 “Tilt Up Concrete”.
   6. Section 03 38 16 “Unbonded Post Tensioned Concrete”.
   7. Section 03 53 00 "Concrete Topping".

1.3 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. American Concrete Institute (ACI):
      a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
      b. ACI 301 – Specifications for Structural Concrete for Buildings
      c. ACI 318 – Building Code Requirements for Structural Concrete
      d. ACI 347 – Guide to Formwork for Concrete
      e. ACI SP-4 – Formwork for Concrete.

1.4 PERFORMANCE REQUIREMENTS

A. Design and engineering of formwork, including shores, reshores, false work, bracing, and other temporary supports as well as determining when temporary supports and bracing can safely be removed after the specified curing time is the Contractor’s responsibility.

B. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

C. If any post tensioned members exist on the project, the formwork supporting those elements shall:
   1. It is essential to take into account the stressing sequence of post-tensioned concrete in the design of the formwork. Any concrete element which is stressed can transfer its weight off the form work to the supporting concrete element in which case the forms for the supporting concrete element must be designed to support the entire load tributary of that element.
   2. Forms shall be designed and constructed to permit movement during stressing, both lifting and shortening of the concrete elements.
   3. Formwork supporting beams and girders shall be designed to support the weight of the beam or girder's entire tributary area.
   4. Formwork supporting post tensioned concrete elements shall not be removed until all concrete supported by the formwork has been fully stressed, but in no case shall the curing time before form removal be less than specified herein.
   5. Design, engineering, and production of shop drawings for the form work shall be performed under the supervision of a professional engineer.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Shop drawings for layout of pan type forms, if they exist on the project. Layout only - information and details about the support of these forms is not required, as it is the responsibility of the Contractor and his registered engineer
   1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

C. Manufacturer's product data and installation instruction for propriety materials used in exposed concrete work including form liners, release agents, form systems, ties, and accessories.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver form materials in manufacturer's packaging with installation instructions.

B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

B. Testing Agency Qualifications: Refer to Section 01 45 23.

C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete."
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Permanent Metal Forms for Slabs: Deck material, gauge and rib pattern shall be as noted on Drawings.

E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
1. Pans shall be free of dents, irregularities, sag, rust or other deterioration.
2. In areas permanently exposed to view, provide one piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.

F. Load-bearing Rigid Board Insulating Fill Under Slabs:
1. Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type X, 15 psi minimum compressive strength, 1.30 lb./cu. ft. (21 kg/cu. m) .
   a. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.
   b. Thermal Resistance: (180-day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
   c. Blowing Agent Formulation: Zero ozone depleting.
   d. Install according to manufacturer's recommended instructions.
2. Expanded Polystyrene Board Insulation: Un-faced Flat Board Stock: Rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578 Type VIII, 15 psi minimum compressive strength .
   a. Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: request info (info@insulfoam.com); Web: www.insulfoam.com
   b. Blowing Agent Formulation: Zero ozone depleting.
   c. Install according to manufacturer's recommended instructions.

G. Formwork Accessories
1. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
2. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
3. Expansion-Contraction Joint Filler Material: Bonded fabric of thickness indicated on Drawings composed of cellular fibers securely bonded together and uniformly saturated with asphalt complying with ASTM D 1751.
4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
5. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   c. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch
3. Class C, 1/2 inch
4. Class D, 1 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts that are attached to the formwork.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
   3. Install dovetail anchor slots in concrete structures as indicated.
   4. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
   3. Determine compressive strength of in place concrete by testing representative field-cured test specimens according to ACI 301.

B. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.

C. In the absence of cylinder tests, formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period.

D. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span. Two-way conventionally reinforced slabs shall then be reshored until they attain the specified 28 day strength.

E. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems that allow form removal without displacing shores. However, the Contractor

must demonstrate, to the satisfaction of the Architect, that the early removal of forms will not result in excessive sag, distortion or damage to the concrete elements.

F. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

G. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. The Contractor shall be solely responsible for proper shoring and reshoring. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

C. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. Reshores shall be located in the same position on each floor. No construction loads shall be placed on the new construction until all supporting reshores have been installed.
   1. Extend shores or reshores from ground to top level in structure three stories or less in height, unless noted otherwise.
   2. In structures over three stories in height, extend shores or reshores at least three levels under the level being placed. Extend shores beyond the minimum number of levels if required to ensure proper distribution of loads throughout the structure.
   3. In crawl spaces or basement, shores or reshores shall extend to mud pads seated firmly on the soil or to on grade construction.

D. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

E. Bottom tier of reshores shall remain in place until the supported concrete has attained at least 85 percent of the specified 28-day compressive strength and construction loads in excess of 20 psf have been removed but not less than 14 days.

3.5 REUSE OF FORMS

A. Clean and repair surfaces of forms to be used in the Work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent.

B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Otherwise, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are to be installed.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
   1. Apply scratch finish to surfaces indicated or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated or to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-

place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment

END OF SECTION 03 10 00

SECTION 03 11 31 - VOID FORMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes corrugated paper void form material to create a temporary support for the placement of structural concrete slabs, grade beams, or walls over expansive soils.

B. Related Sections:
1. Section 01 45 23 “Testing and Inspection Services”.
2. Section 03 33 00 "Architectural Concrete".
3. Section 03 30 00 “Cast In Place Concrete”.
4. Section 03 20 00 “Concrete Reinforcing”.
5. Section 03 47 13 “Tilt Up Concrete”.
6. Section 03 38 16 “Unbonded Post Tensioned Concrete”.

1.3 PERFORMANCE REQUIREMENTS

A. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated including manufacturer’s written installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver form materials in manufacturer’s packaging with installation instructions.

B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.6 QUALITY ASSURANCE

A. Design, place, and maintain void forms or carton forms for cast in place concrete work in compliance with ACI 347 “Guide to Form Work” unless otherwise shown or specified.

B. Testing Agency Qualifications: Refer Section 01 45 23.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads, but not less than 800 pounds per square foot. Interior components shall be constructs as shown below:
   1. Extra Fast Decomposition – Non wax impregnated, plain kraft paper and a water soluble adhesive.
   2. Fast Decomposition – Non wax impregnated, plain kraft paper and a moisture resistant adhesive.
   3. Moderate Decomposition – Plain kraft paper with a wax impregnated medium, but non wax impregnated liners and a moisture resistant adhesive.
   4. Slow Decomposition – Plain kraft paper with wax impregnated medium / liners and a moisture resistant adhesive.
   5. Extra Slow Decomposition – Wet strength paper with wax impregnated medium / liners and a moisture resistant adhesive.

2.2 VOID BOXES

A. Slabs: Use “Slab Void” with interior cell sizes 8”x8” or smaller, capable of sustaining a working load 800 psf, for slabs 8 inches thick or less. For slabs between 8 inches thick and 12 inches thick, void box shall be capable of sustaining a working load of 1000 psf. For slabs greater than 12 inches thick, consult with the structural engineer. For interior piers, provide pre-manufactured curved end units against top of piers for tight fit.

B. Grade beams and walls: Rectangular shape as shown on plans. Trapezoidal void boxes are not acceptable. Provide end caps at ends of forms and corners. Provide pre-manufactured curved end units against top of piers for tight fit. Cartons shall be capable of sustaining a working load of 200 psf times the height of the pour (in feet), without significant deformation.

C. Design and maintain void forms to maintain all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. This includes, but is not limited to, live load, dead load, and weight of moving equipment, height of concrete drop, vibrator frequency, ambient temperature, soil pressures, and lateral stability.

D. Form material shall be designed to lose it strength upon prolonged contact with the moisture that normally accumulates beneath slabs and beams on grade. Sufficient deterioration to cushion uplift forces shall take place within a maximum of 8 weeks after placement of concrete.

2.3 RELATED PRODUCTS

A. Protection Board: Used over carton forms under slabs and under grade beam or walls wider than 12 inches. 1/4-inch minimum hardboard.

B. Soil Retainers: High density, polyethylene (HDPE). “Sure Retainer” by Motzblock or ½ inch thick “Backfill Retainer” by Sure Void Products. Retainers shall be sized such that they extend a minimum of 4 inches above the void box and 4 inches below the void box.

PART 3 - EXECUTION

3.1 CARTON FORMS

A. A void shall be constructed below all structural elements supported by piers to separate these elements from the soil. Where carton forms are used to construct this void the construction shall comply with the following:
   1. Seal discontinuous ends of carton forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between carton form sections.
   2. Pre-manufactured carton forms with circular edges shall be used around all drilled piers. Cutting of square carton forms is not acceptable.
   3. Do not allow any portion of carton forms to fall within the circumference of piers causing reduction in bearing area.
   4. Protect carton forms from water. Do not install carton forms during wet weather or on wet ground. Carton forms which become wet prior to placement of concrete shall be removed and replaced.
   5. Protect carton forms, from puncturing, collapsing, or crushing during construction. All damaged carton forms must be replaced prior to concrete placement.
   6. Exercise care in placement of concrete to avoid collapse of carton forms. If carton forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created and protected by installing the specified soil retainers.
   7. Carton forms wrapped in plastic to protect them from water, shall have the plastic ripped or punctured immediately prior to concrete placement.

B. Carton Forms Under Slabs
   1. Carton forms under slabs shall be protected on top by a protection board as specified with the specified vapor retarder on top of the protection board.
   2. Carton forms shall not be placed under soil supported slabs on grade.

END OF SECTION 03 11 31

SECTION 03 15 13 - WATERSTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.

B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.

C. Non-metallic waterstops for use in concrete joints subjected to acids, bases, alcohols, oils, solvents, or other chemicals.

1.3 REFERENCES

A. PVC WATERSTOP
1. Corps of Engineers: CRD-C 572-74
2. American Society for Testing Materials (ASTM)
3. Bureau of Reclamation: C-902
4. Canadian General Standards Board: 41-GP-35M Types 1 & 3
5. ACI 350.2: Concrete Structures for Containment of Hazardous Materials

B. HYDROPHILIC WATERSTOP
1. American Society for Testing Materials (ASTM)

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

1.5 SUBMITTALS

A. Submit shop drawings and fabrication drawings indicating placement of waterstops and shop fabrications.

B. Submit manufacturer’s test data for chemical resistance.

PART 2 - PRODUCTS

2.1 PVC WATERSTOPS FOR EXPANSION JOINTS

A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak or approved equal.

B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.

C. Profile: Ribbed with center bulb.

D. Dimensions: 6 inches by 3/8 inch thick.

E. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F
Stiffness in Flexure	ASTM D 747	600 psi min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalis after 7 days: Weight Change Hardness Change	CRD-C 572	 between -0.10% / +0.25% +/- 5 points

2.2 CHEMICALLY RESISTANT FLEXIBLE WATERSTOP

A. Thermoplastic elastomeric rubber waterstops resistant to oil, solvents, and chemicals as manufactured by Westec or approved equal.

B. Chemical resistance testing to be performed by independent ASTM certified laboratory.

C. Profile: Ribbed with center bulb

D. Dimensions: 6 inches by 3/8 inch thick.

E. Performance requirements as follows:

Property	Test Method	Unexposed Value
Tensile Strength	ASTM D638	2000 psi
Ultimate Elongation	ASTM D638	450%
100% Modulus	ASTM D638	1000 psi
Shore A Hardness	ASTM D2240	85 units
Low Temp Brittleness	ASTM D746	No Failure @ -70 F

F. Waterstop material should show less than +/- 30% change in material properties, including weight gain after 7-day exposure to selected chemicals, per ASTM D 471 testing.

2.3 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS

A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number (fill in profile style number).

B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

D. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

Modified Chloroprene (Hydrophilic) Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70o F	3 to 1 min.

2.4 ACCESSORIES

A. PVC and Chemically Resistant Waterstops
1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
3. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.
4. Splices to be free from defects.

B. Hydrophilic Waterstops
1. Provide Greenstreak 7300 two component epoxy gel to secure HYDROTITE to rough, wet (or dry) concrete.

2. Provide LEAKMASTER single component hydrophilic sealant to secure HYDROTITE to rough, dry concrete.
3. Provide cyanacrylate adhesive (super glue) for all splices.
4. Provide LEAKMASTER as addition to cyanacrylate adhesive at all splices for added insurance (Optional).

PART 3 - EXECUTION

3.1 INSTALLATION

A. PVC and Chemically Resistant Waterstops
1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12” on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.
4. Install in longest lengths practicable.
5. Ensure steel reinforcing bars do not interfere with proper position of waterstop.
6. Clean concrete joints of dirt and construction debris prior to second pour of concrete.
7. Cut waterstop ends with miter guide and circular saw to ensure good, full contact at joints.
8. At expansion joints, keep center bulb unembedded at joint centerline.

B. Hydrophilic Waterstop
1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER (LEAKMASTER is optional).
3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
4. Follow approved manufacturer written recommendations.
5. Install in longest length practicable.

C. Hydrophilic and PVC Intersections
1. Maintain continuity of waterstops at all intersections and transitions.
2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
3. Follow approved manufacturer written recommendations.

D. Retrofit Waterstop
1. Prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond.
2. Apply continuous bed of epoxy to concrete 1/8 inch thick.
3. Embed retrofit waterstop in uncured epoxy.
4. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6 inches OC max. Use batten bars on top and bottom.
5. Tool continuous layer of epoxy over batten bars and bolts to protect from corrosion.
6. Use expansion joint filler at moving joints to minimize shear stresses.

E. Concrete Placement at Waterstop
1. Carefully place concrete without displacing waterstop from proper position.
2. Thoroughly and systematically vibrate concrete around waterstop to obtain impervious, void free concrete in vicinity of joint and to maximize intimate contact between concrete and waterstop.
3. After first pour, clean un-embedded waterstop leg to ensure full contact of second pour concrete.

END OF SECTION 03 15 13

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete reinforcement, for the following:
   1. Footings and/or piers.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

B. Related Sections:
   1. Section 01 45 23 “Testing and Inspection Services”.
   2. Section 03 10 00 “Concrete Forming and Accessories”.
   3. Section 03 30 00 “Cast In Place Concrete”.
   4. Section 03 47 13 “Tilt Up Concrete”.
   5. Section 03 38 16 “Unbonded Post Tensioned Concrete”.
   6. Section 04 22 00 “Concrete Unit Masonry”.
   7. Section 31 20 00 "Earth Moving".
   8. Section 31 63 29 "Drilled Concrete Piers".

1.3 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. American Concrete Institute (ACI)
      a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
      b. ACI 301 – Specifications for Structural Concrete for Buildings
      c. ACI 315 – Details and Detailing of Concrete Reinforcement
      d. SP-66 ACI Detailing Manual
   2. American Welding Society (AWS)
      a. AWS D1.1 – Structural Welding Code
   3. Concrete Reinforcing Steel Institute (CRSI)
      a. CRSI – Manual of Standard Practice
      b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
      c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
   4. American Society of Testing Materials (ASTM)

a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.

B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 “Details and Detailing of Concrete Reinforcement.”
1. Do not reproduce the structural drawings for use as shop drawings.

C. Bar Supports: Submit manufacturer’s product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
1. Steel reinforcement and accessories.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer Section 01 45 23.

B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4, "Structural Welding Code - Reinforcing Steel."

E. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 75 as indicated on Drawings, deformed.

C. Low-Alloy-Steel Reinforcing Bars for bars to be welded: ASTM A 706, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.

D. Add the following paragraph below for stainless-steel reinforcement. Retain one of two options for reinforcement type.

E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.

F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.

G. Plain-Steel Wire: ASTM A 82, as drawn.

H. Deformed-Steel Wire: ASTM A 496.

I. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:
1. Sheared length: Plus or minus 1 inch.
2. Depth of truss bars: Plus 0, minus ½ inch.
3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
4. Other bends: Plus or minus 1 inch.

B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

2.4 DOWEL BAR ANCHORS/SPLICERS

A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable.
1. Richmond Screw Anchor “Dowel Bar Splicer”
2. Erico “Lenton Form Saver”
3. Dayton Barsplice “Grip-Twist”

2.5 MECHANICAL SPLICES

A. A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O test reports. The following bar splicing systems are acceptable.
1. Erico “Cadweld C-Series”
2. Erico “Lenton”
3. Dayton Barsplice “Bar Grip”

4. Dayton Barsplice “Grip Twist”

2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: Conform to ASTM A36, “Specification for Structural Steel”.

B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

C. Welding Electrodes: AWS 5.5, Series E70.

D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

E. All metal assemblies exposed to earth, weather, or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES

A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC “Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings,” and AWS D1.1. Welding shall be done by AWS certified welders.

B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.

C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.

D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.2 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.

G. Place bars to following tolerances:
1. Clear distance to formed surfaces: Plus or minus 1/4 inch.
2. Minimum spacing between bars: Minus 1/4 inch.
3. Top bars in slabs and beams:
   a. Members 8 inches deep or less: Plus or minus 1/4 inch.
   b. Members between 8 and 24 inches deep: Plus or minus 1/2 inch.
   c. Members more than 24 inches deep: Plus or minus 1 inch.
4. Crosswise of members: Spaced evenly within 2 inches.
5. Length of members: Plus or minus 2 inches.

H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.

I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.

J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspecting: See Section 01 45 23.

B. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

B. Related Sections:
   1. Section 01 45 23 “Structural Testing and Inspection Services”.
   2. Section 03 20 00 "Concrete Forming and Accessories".
   3. Section 03 10 00 "Concrete Reinforcing".
   4. Section 03 11 31 “Void Forms”.
   5. Section 03 15 13 “Waterstops”.
   6. Section 03 05 80 “Under-slab Vapor Barrier – Retarder”.
   7. Section 03 47 13 “Tilt Up Concrete”.
   8. Section 31 63 29 “Drilled Concrete Piers and Shafts”.

1.3 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
   1. ACI 301 – Specification for Structural Concrete.
   2. ACI 302 – Guide for Concrete Floor Slab Construction.
   3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305 – Hot Weather Concreting.
   5. ACI 306 – Cold Weather Concreting.
   6. ACI 308 – Guide to Curing Concrete.
   7. ACI 309 – Guide for Consolidating Concrete.
   8. ACI 311 – ACI Manual for Concrete Inspection.
   9. ACI 318 – Building Code Requirements for Reinforced Concrete.
   10. ACI 347 – Guide to Concrete Formwork.
   11. ACI 207 – Mass Concrete.
   12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
14. ACI 212.3 – Chemical Admixture for Concrete.
15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
16. ACI 214 – Evaluation of Strength Test Results of Concrete.
17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
18. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.

B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
2. Proportions of cement, fine, and coarse aggregate, and water.
3. Design strength.
4. Maximum slump.
5. Air Content.
6. Maximum water / cement ratio.
7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
8. Type cement and aggregates.
9. Type and quantities of all admixtures.
10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
11. Type, color, and quantities of integral coloring compounds, where applicable.
12. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.

D. Formwork Shop Drawings: Refer Section 03 10 00.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Semi rigid joint filler.
9. Joint-filler strips.
10. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: See Section 01 45 23.
1. Contractor’s responsibility to testing laboratory.
   a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
   b. Advise the Owner’s Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.

c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.

H. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. See Section 03 10 00.

2.2 STEEL REINFORCEMENT

A. See Section 03 20 00.

2.3 REINFORCEMENT ACCESSORIES

A. See Section 03 20 00.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.

D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride (except the chemical admixture Xypex).
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. Retarding Admixture: ASTM C 494, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
   7. Waterproofing Admixture: Xypex Admix C-1000

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ChemMasters.
      b. Davis Colors.
      c. Dayton Superior Corporation.
      d. Hoover Color Corporation.

e. Lambert Corporation.
f. QC Construction Products.
g. Rockwood Pigments NA, Inc.
h. Scofield, L. M. Company.
i. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

2.6 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. 3M; Scotchcast Polyolefin Fibers 2".
   b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
   c. FORTA Corporation; FORTA FERRO.
   d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
   e. Nycon, Inc.; XL.
   f. Propex Concrete Systems Corp.; Fibermesh 650.
   g. Sika Corporation; Sika Fiber MS or MS10.

2.7 CONCRETE MIX DESIGNS

A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.

B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'c by the amount defined in ACI 301.

2.8 VAPOR RETARDERS

A. See Section 03 05 80.

2.9 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Anti-Hydro International, Inc.; Emery.
   b. Dayton Superior Corporation; Emery Tuff Non-Slip.
   c. Lambert Corporation; EMAG-20.
   d. L&M Construction Chemicals, Inc.; Grip It.
   e. Metalcrete Industries; Metco Anti-Skid Aggregate.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Anti-Hydro International, Inc.; A-H Alox.
      b. L&M Construction Chemicals, Inc.; Grip It AO.
      c. Master Builders Solutions; MasterTop 120SR (Pre-2014: Frictex NS)

2.10 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ChemMasters; Chemisil Plus.
      b. ChemTec Int'l; ChemTec One.
      c. Conspec by Dayton Superior; Intraseal.
      d. Curecrete Distribution Inc.; Ashford Formula.
      e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
      f. Edoco by Dayton Superior; Titan Hard.
      g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
      h. Kaufman Products, Inc.; SureHard.
      i. L&M Construction Chemicals, Inc.; Seal Hard.
      j. Meadows, W. R., Inc.; LIQUI-HARD.
      k. Metalcrete Industries; Floorsaver.
      l. Nox-Crete Products Group; Duro-Nox.
      m. Symons by Dayton Superior; Buff Hard.
      n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
      o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Advanced Floor Products; Retro-Plate 99.
      b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
      c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
      b. ChemMasters; SprayFilm.

c. Conspec by Dayton Superior; Aquafilm.
d. Dayton Superior Corporation; Sure Film (J-74).
e. Edoco by Dayton Superior; BurkeFilm.
f. Euclid Chemical Company (The), an RPM company; Eucobar.
g. Kaufman Products, Inc.; Vapor-Aid.
h. Lambert Corporation; LAMBCO Skin.
i. L&M Construction Chemicals, Inc.; E-CON.
j. Master Builders Solutions; MasterKure ER 50 (Pre-2014: Conflim).
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior; W.B. Resin Cure.
d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
e. Edoco by Dayton Superior; Res X Cure WB.
f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; AQUA KURE - CLEAR.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100-CLEAR.
k. Nox-Crete Products Group; Resin Cure E.
l. Right Pointe; Clear Water Resin.
m. SpecChem, LLC; Spec Rez Clear.
n. Symons by Dayton Superior; Resi-Chem Clear.
o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ChemMasters; Polyseal WB.
   b. Conspec by Dayton Superior; Sealcure 1315 WB.
   c. Edoco by Dayton Superior; Cureseal 1315 WB.
   d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
   e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
   f. Lambert Corporation; UV Safe Seal.
   g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
   h. Master Builders Solutions; MasterKure CC 1315WB (Pre 2014: Kure1315).
   i. Meadows, W. R., Inc.; Vocomp-30.
   j. Metalcrete Industries; Metcure 30.
   k. Right Pointe; Right Sheen WB30.
   l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
   m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 NON-SHRINK GROUT

A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in

temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:

1. “Euco NS” by Euclid Chemical Company
2. “Masterflow 713” by Master Builders.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

2.17 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. See Section 03 10 00.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. See Section 03 10 00.

3.4 SHORES AND RESHORES

A. See Section 03 10 00.

3.5 VAPOR RETARDERS/BARRIERS

A. See Section 03 05 80.

3.6 STEEL REINFORCEMENT

A. See Section 03 20 00

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Do not permit concrete to drop freely any distance greater than 10’-0” for concrete containing a high range water reducing admixture or 5’-0” for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

H. Hot-Weather Placement: Comply with ACI 305 and as follows:
   1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. See Section 03 10 00.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
   1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated and/or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated and/or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish surfaces according to ASTM E 1155, for a randomly trafficked floor surface.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

3.11 CONCRETE FLOOR FINISH TOLERANCES

A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, Fl =25; with minimum local values of flatness, Ff =24; and levelness, Fl =17.
2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, Fl = 20; with minimum local values of flatness, Ff =17; and levelness, Fl =15.

B. Floor Elevation Tolerance Envelope:
1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
   a. Slab-on-Grade, or Slab-on-Void Construction: +/- 3/4"
   b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
   c. Top surfaces of all other slabs: +/- 3/4"
   d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven

days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer’s written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days' old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
   1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
   2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
   3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
   4. Control and dispose of waste products produced by grinding and polishing operations.
   5. Neutralize and clean polished floor surfaces.

C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
   3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
   1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   2. After concrete has cured at least 14 days, correct high areas by grinding.
   3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: See Section 01 45 23.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
NOTE: Add articles for flowable fill in products and execution. NEEDS RESEARCH.

END OF SECTION 03 30 00

SECTION 03 52 16 - LIGHTWEIGHT INSULATING CONCRETE DECK SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. It is the intent of this Section,
   1. to include the lightweight insulating concrete, and EPS roof insulation for all areas of existing roof construction, and
   2. that all Work be performed by the lightweight insulating concrete Sub-contractor.

1.2 RELATED WORK

A. All Sections of Work pertinent to the roofing system, including mechanical, plumbing and electrical items penetrating metal deck, lightweight insulating concrete, rough carpentry, roof insulation, subsequent roofing and sheet metal flashing and trim.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications, instructions and other data needed for proper placement of the lightweight insulating concrete roof insulation system.
   2. Manufacturer's installation instructions.

B. Mix Design: Indicate materials and proportions of proposed mix.

C. Applicator’s Qualifications: Submit a letter from the proposed lightweight insulating concrete system supplier confirming that the Contractor is approved to install the proposed lightweight insulating concrete system. Refer also to Paragraph 1.5, A.

D. Certifications:
   1. Manufacturer’s affidavit that materials used in Project contain no asbestos.
   2. On completion of installation, furnish Architect with Certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.
   3. Manufacturer’s certification that system meets or exceeds UL-90 wind up-lift and UL Class A fire rating.
   4. Manufacturer’s certification that system meets or exceeds Factory Mutual Research Corp. FM I-90 wind up-lift rating.

E. Warranty:
   1. Submit a sample copy of the warranty covering the proposed lightweight insulating concrete system.
   2. Submit a sample copy of the roof system warranty covering the proposed lightweight insulating concrete system and roof membrane system.
   3. Refer to the roofing system specification section and coordinate the lightweight insulating concrete system warranty with the roof system warranty.

1.4 REFERENCES

A. Comply with all applicable recommendations of the referenced standards. In any conflict between referenced standards, the more stringent requirements shall govern.
   1. American National Standards Institute/Underwriters' Laboratories, Inc. (ANSI/UL)
   2. American Society for Testing and Material (ASTM)
      a. A525, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
      b. C150, Standard Specification for Portland Cement
      c. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
      d. C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete
      e. C495, Standard Test Method for Compressive Strength of Lightweight Insulating Concrete
      f. E119, Standard Test Methods for Fire Tests of Building Construction and Materials
   3. National Roofing Contractors Association (NRCA)
   4. Occupational Safety and Health Administration (OSHA)
   5. Underwriters' Laboratories, Inc. (UL)
      a. Wind Uplift Class 90 - UL-90
      b. Fire Ratings - Class A
   6. Vermiculite Association (VA)

1.5 QUALITY ASSURANCE

A. Applicator:
   1. A firm regularly engaged in and properly equipped for the installation of lightweight fill, and acceptable to the fill manufacturer, which has installed at least five (5) million square feet in the last five (5) years.
   2. Key Person Requirement: A thoroughly trained and experienced employee of the Installer, who is acceptable to the Roofing Consultant, shall be present at all times during the execution of work specified in this Section, and direct that work.
   3. Approved in writing by manufacturer to install the roof lightweight insulating concrete deck system.
   4. Responsible for ensuring positive drainage.
   5. **No ponding** water will be acceptable.
   6. Perform water test prior to application of roof system. Architect will be present, provide 48 hours' notice in advance of water testing.

B. Agency Approvals: Provide products, execution, and material thickness to conform to the applicable code requirements for the required fire resistance ratings, wind uplift classifications, insulation values, and diaphragm values.

C. Diaphragm Construction: Incorporate metal decking thickness, welding pattern, and minimum compressive strength of the lightweight insulating concrete to achieve diaphragm design values for edge and field conditions as specified to meet applicable code requirements.

D. Fire Resistance Classifications: Provide a lightweight insulating concrete system meeting the following fire resistance standards:
   1. Tested by UL in accordance with the procedures of ASTM E119 and listed in the UL "Fire Resistance Directory".
   2. Approval Rating: Class A

E. Wind Uplift Classifications: Provide a lightweight insulating concrete system meeting the following wind uplift standards:

1. Tested by UL in accordance and listed in the UL “Roofing Materials Directory” for wind uplift resistance.
2. Approval Rating: UL-90
3. Tested and approved by Factory Mutual Research Corp. for wind up-lift rating of I-90.

F. Inspection and Testing Laboratory Services:
1. Test results shall meet or exceed established Standards. Refer to Section 01115, Inspection and Testing Laboratory Services.
2. The Owner will select the Inspection and Testing Laboratory and pay for the cost of tests to determine the dry density and compressive strength.
3. Compressive strength shall be determined in accordance with ASTM C495.
4. Wet and dry density range shall be in accordance with ASTM C495.
5. Polystyrene (EPS) density shall be in accordance with ASTM C578.

G. Building / Construction Components: Meet or exceed established standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened packaging fully identified as to manufacturer, brand or other identifying data as approved in submittal documents.

B. Store materials under cover, and in a dry location until ready for installation. Roofing insulation must always be covered or stored in a dry area when not being used.

C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload the structure.

D. Familiarize every member of the installation crew with the manufacturer’s material safety data sheets and with fire and safety regulations recommended by OSHA, NRCA, and as required by governing codes of authorities having jurisdiction.

1.7 PROJECT / SITE CONDITIONS

A. When air temperatures of 40 degrees F or above are predicted to occur within the first 24 hours after placement, normal application procedures may be used.

B. When air temperatures of 32 degrees F - 40 degrees F are predicted to occur within the first 24 hours after placement, warm water not exceeding 90 degrees F may be used.

C. Do not place the lightweight insulating concrete system when air temperatures are below 40 degrees F, including wind chill.

D. Insulating Lightweight Concrete Fill Installer shall be responsible for protecting the new insulating lightweight concrete deck from all adverse conditions until roofing begins.

1.8 SEQUENCING AND SCHEDULING

A. Sequence and coordinate application of lightweight insulating concrete roof insulation with work in other sections so as not to interfere with efficient roof insulation application.

1.9 WARRANTY

A. Manufacturer's Warranty: Warrant the decking and associated Work in conjunction with the roofing manufacturer from the project date of Substantial Completion as follows:
   1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost. Refer to roof system specification section for length of warranty period.
   2. The warranty shall provide manufacturer's maximum extended wind rated coverage (up to Hurricane force winds) as defined by the Beaufort Scale.
   3. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
   4. The full system warranty including lightweight insulating concrete deck, roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.

B. Contractor Warranty: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the lightweight insulating concrete deck will be and remain in good condition for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty.

C. Make arrangements with the roofing manufacturer to provide the required warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Products and manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
   1. Elastizell Corp. of America
   2. Siplast, Inc.
   3. Vermiculite Products Inc.
   4. Celcore, Inc.
   5. Mearlcrete

2.2 MATERIALS

A. Metal Deck: Refer to Section 05 31 00. Corrugated steel decking incorporating a pre-applied galvanized coating conforming to ASTM A653, minimum Class G-90 and having slots in flutes equal to a minimum of 0.75 percent of the deck area. Refer to Structural Drawings for size, type and section modulus of metal deck and for welding pattern of deck.

B. Insulation Board:
   1. Type: Expanded polystyrene (EPS) insulation board Type I by ASTM C578 and containing approximately three (3) percent open area.
   2. Thickness: 6 inches thick minimum, unless shown otherwise.
   3. Approved Products / Manufacturers:

a. "Insulperm" manufactured by Siplast, Irving, Texas (800) 922-8800.
b. “Starrfoam-HB” manufactured by Starrfoam Manufacturing, Inc., Fort Worth, Texas (817) 654-4688.
c. “Vermaperm” manufactured by Vermiculite Products Inc., Houston, Texas (713) 869-6663.
d. “Holey Board” manufactured by Houston Foam Plastics, Houston, Texas, (713) 224-3612.
e. PowerFoam, manufactured by PowerFoam, Midolathian Texas 972-299-5556

C. Water: Potable water that is clean and free of deleterious amounts of acid, alkali, and organic materials – (Drinkable).

D. Cement: Portland type, conforming to ASTM C150, Type I or III.

E. Foam Concentrate: Protein based foam concentrate conforming to ASTM C 869 and ASTM C 796.

F. Vermiculite Aggregate: Any one (1) of the following products from a single manufacturer is approved for use on this Project:
1. Vermiculite: Comply with ASTM C332, produced by a current member of VA. Mix shall be 1:6 with 300 (min) psi at 28 days compressive strength; 48 to 60 pcf wet density, and 25 to 32 pcf dry density.
2. Cellular: Mix shall be 1:3 with minimum compressive strength of 300 psi, cast density of 34-42 pcf, manufactured by Elastizell Corporation of America, Ann Arbor, MI (734) 761-6900

G. Admixtures: Air entraining types and superplacticizer (water reducer) types as recommended by insulating concrete material manufacturer. Admixtures may be injected into material at the plant. The use of calcium chloride is not permitted.

H. Expansion Joint Material: One (1) inch thick of type recommended by insulating concrete material supplier for expansion joints in structural system.

I. Reinforcing: 3/4 inch long, polypropylene fiber, Fibermix as manufactured by Fibermesh Co. for cellular concrete only.

J. Nailers: (Refer to Section 06 10 00, Rough Carpentry) As shown on drawings. Install required thickness of wood to align with specified thickness of lightweight insulating concrete.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to placing reinforcing and insulating concrete, inspect to ensure all piping, curbs, wood nailers, etc., have been raised to the proper height and the substrate is free of any foreign materials.

B. Ensure perimeter edge and penetrations are sealed in a watertight fashion.

C. Ensure temporary roof is installed as specified in Section 07 52 19.

3.2 PREPARATION

A. Notify other trades of dates of pouring in ample time for each to install his work.

B. Review required finishes and allowable tolerances for surface defects.

C. Set screeds so various deck thicknesses are maintained uniformly in place with all slopes as shown and detailed on drawings.

D. Verify with the appropriate type instrument that all roof areas have positive drainage. Areas lacking positive drainage are unacceptable and shall be removed and re-poured at Contractor's expense.

3.3 INSTALLATION

A. Metal Deck: Place sheets with corrugation edges upon the perpendicular to supports with end laps centered over supports. Attach to supports with plug welds through welding washers. Refer to Structural Drawings for additional requirements.

B. Expansion Joint Material: Install at the following locations.
1. Perimeter of deck.
2. Changes in direction of roof deck.
3. Structural roof penetrations and expansion joints

C. Provide equipment and installation procedures conforming to the materials manufacturer’s installation instructions.

D. Mix Portland cement and aggregate in a mix ratio design with water in accordance with manufacturer’s instructions to achieve the specified wet density, minimum dry density, and minimum compressive strength.

E. Install slurry coat of lightweight insulating concrete over metal deck to minimum thickness of 1/4 inch over top of flutes of metal decking.

F. Place insulation boards into slurry within 30 minutes of applying lightweight insulating concrete in accordance with manufacturer’s instructions.

G. Place insulation board with joints staggered in a brick-like running bond pattern.

H. Hold board back two (2) inches from the perimeter of the roof areas and all roof top units.

I. Butt boards together and place so as to provide full contact of slurry with board, causing insulating concrete fill to enter the locking/keying openings in the insulation board.

J. Walk insulation board into slurry to ensure proper embedding of insulation boards into lightweight insulating concrete and keying with insulation holes.

K. Fill holes in the insulation boards and place a two (2) inch minimum thickness of lightweight insulating concrete over top of the insulation boards within four (4) hours after installation of insulation boards.

L. Build all crickets and saddles shown with lightweight insulating concrete sloped to drain as indicated on drawings.

M. Deposit insulating concrete fill and screed (without troweling, rodding, tamping, or vibrating) immediately after mixing. Place on surfaces clean and free of loose material. Place no concrete when temperature is 40 degrees F or falling.

N. All wood blocking for deck penetrations support and low roof deck to rise wall blocking shall be installed one (1) inch higher than designed lightweight fill thickness. Install fill in a two (2) foot tapered edge condition.

O. Allow insulating concrete fill to dry as thoroughly as possible before application of roofing, and not less than the minimum time recommended by the manufacturer. Begin roofing when the insulating concrete fill can withstand construction traffic (usually two (2) to three (3) days after placement), verify / confirm with manufacturer's recommendations. Do not leave insulating concrete fill deck surface exposed for longer than ten (10) days. Install no more insulating concrete fill than can be roofed within the ten (10) day time limit. Maximum unroofed insulating concrete deck shall be 5,000 square feet; no exceptions.

P. Where material is to be pumped, equipment shall be in good condition and well maintained to avoid equipment failure and delays.

Q. Install and cure lightweight insulating concrete in accordance with manufacturer's instructions.

R. Avoid roof-top traffic over the lightweight insulating concrete deck system until 24 hours have elapsed after last placement of lightweight insulating concrete.

S. Allow lightweight insulating concrete to dry as thoroughly as possible before application of roofing. Testing Laboratory may perform tests to determine moisture content of lightweight insulating concrete.

T. Add two (2) pounds of fiber reinforcing per cubic yard of lightweight insulating concrete if cellular concrete is used.

3.4 FIELD QUALITY ASSURANCE

A. The Owner will select the independent inspection and testing laboratory and pay for the cost of tests in accordance with Division 1.

B. The independent inspection and testing laboratory will randomly sample and verify the following:
1. Thermal insulation value in accordance with ASTM C177.
2. Mix design compressive strength in accordance with ASTM C495.
3. Mix design wet and dry density range in accordance with ASTM C495.
4. Polystyrene insulation density in accordance with ASTM C578.

C. Contractor shall provide base ply fastener pull tests prior to installation of roofing system, following the installation of the lightweight insulating concrete to ensure a minimum withdrawal resistance of 40 pounds per fastener.

D. Results of all tests will be made available to all concerned parties.

E. Water Test: Run water on the finished deck for the Architect's observation. The lightweight insulating concrete shall slope to drain and no ponding of water will be accepted. No slopes less than 1/4 inch per foot will be allowed.

F. Certification: On completion of installation, furnish Architect with certificate signed by a representative of the manufacturer and by the applicator stating that insulating concrete was prepared and applied in accordance with manufacturer's recommendations.

3.5 ADJUSTING AND CLEANING

A. Remove ridges, surface depressions and other surface irregularities which are unacceptable to the roofing contractor and Architect.

B. Completely remove all insulating concrete fill from any surface on which it is not intended to be placed.

C. Perform all patching and repairing of insulating concrete using Zono-Patch or other materials approved by the lightweight insulating concrete supplier.

3.6 PATCHING AND REPAIRING

A. Perform all patching and repairing of lightweight insulating concrete using the same materials specified in this Section or materials approved by the system manufacturer.

B. The party responsible for damage will be charged for repairs.

3.7 PROTECTION

A. Lightweight insulating concrete installer shall be responsible for protecting newly applied decks from all adverse conditions until Roofing Contractor begins installation of specified roof system.

B. General Contractor shall be responsible for protection of roof deck from other trades until it has been approved for traffic by installer.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Concrete masonry units (CMU)

B. Face brick, including solids.

1.3 DEFINITIONS

A. CMU: Concrete masonry unit.

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 RELATED WORK

A. Section 01 45 23 - Testing and Inspecting Services.

B. Section 05 50 00 – Metal Fabrications. Steel masonry lintels.

C. Section 07 11 00 – Bituminous Dampproofing.

D. Section 07 21 00 – Thermal Insulation.

E. Section 07 92 00 – Joint Sealants.

F. Section 09 90 00 – Paintings and Coatings.

G. All Sections of Work built-in, adjacent to, or applied to unit masonry Work.

1.5 REFERENCES

A. ASTM International (ASTM)
1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron & Steel Hardware.
2. A307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
3. A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
5. C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
6. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
7. C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
8. C144 - Standard Specification for Aggregate for Masonry Mortar.
9. C150, Standard Specification for Portland Cement.
10. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
11. C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
12. C270 - Standard Specification for Mortar for Unit Masonry.

13. C331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
14. C332 - Standard Specification for Lightweight Aggregates for Insulating Concrete.
15. C404 - Standard Specification for Aggregates for Masonry Grout.
16. C476 - Standard Specification for Grout for Masonry.
17. C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
18. C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
19. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
20. C979 - Standard Specification for Pigments for Integrally Colored Concrete.
21. C714 -
22. D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
23. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
24. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. The Masonry Society (TMS).
   1. TMS 402 / 602: Building Code Requirements and Specification for Masonry Structures.

C. Underwriters' Laboratories, Inc. (UL).

1.6 QUALITY ASSURANCE

A. Where requirements of this Section are in conflict with requirements noted on the Structural Drawings, the Structural Drawings shall take precedence. Refer to Structural Drawings for information on load-bearing CMU walls.

B. Fire Performance Characteristics: Where indicated or required, provide materials and construction which are identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L. or other recognized testing and inspection organization or by other means, acceptable to authority having jurisdiction.

C. Masonry Cleaning: Workers shall have minimum 5 years of masonry cleaning experience, and shall be approved by cleaner manufacturer prior to application of cleaning material, and shall meet with cleaner manufacturer for demonstration and instruction s for use of product prior to application.

D. Perimeter Walk-Around: Daily perimeter walk-around the exterior side of the masonry by the GC and or masonry Subcontractor at the end of each Work day as a visual inspection looking for obvious issues or flaws concerning colors, finishes, workmanship, protection of Work.

E. CMU must exceed unit strength required to satisfy f'm 2000 psi (2500 psi) per TMS 402/602. Contractor my document compliance with actual prism tests provided tests are performed 28 days prior to beginning work on site.

F. Single Source Responsibility:
   1. For Masonry Units: Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one (1) manufacturer for each different product required for each continuous surface or visually related surfaces.
   2. For Mortar and Grout Materials: Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work where exposed to view and where not scheduled to receive a subsequently applied finish, i.e. parging, painting, etc., unless directed otherwise in writing by the Architect.

3. Contractor's Responsibility: Contractor performing Work of this Section shall be responsible for coordinating with others performing Work which is built-in or adjacent to unit masonry Work.

1.7 SUBMITTALS

A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Samples: Two (2) sets of color chips representing manufacturer's full range of available colors and textures of each face brick for Architect's selection and approval.

C. Sample Panel(s):
1. Do not start masonry until Architect has approved samples.
2. Sample panel shall be 6 feet long by 8 feet high showing selected color range and texture, bonding, joint shape, and quality of workmanship. Include a brick and expansion joint, and any specialty details, such as reveals, soldier courses, etc. Include mock-up of installation of thru-wall flashing at foundation sill and lintel above openings, window jambs and sills.
3. A separate panel for each type of masonry used is required.
Sample panel(s) shall remain at the jobsite until all masonry is completed.
Installed materials shall be visible and integrated into adjacent materials.
4. Brace and support as required to withstand structural wind loads.

D. Certification: Submit manufacturer's affidavit that materials used in Project contain no asbestos.

E. Mortar and Grout Mix Designs: Submit two (2) copies of proposed mortar and grout mix designs to Owner's testing laboratory.

1.8 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for typical exterior and interior walls in sizes approximately 72 inches (1800 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.
    a. Include a sealant filled joint at least 16 inches (400 mm) long in each mockup.
    b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
    c. Include through wall flashing installed for a 24 inch (600 mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12 inch (300 mm) length of flashing left exposed to view (omit masonry above half of flashing).
    d. Include studs, sheathing, water resistive barrier, sheathing joint and penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry veneer wall mockup.
    e. Include each type of masonry on one face of interior unit masonry wall mockup.

3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
4. Clean one/half of exposed faces of mockups with masonry cleaner as indicated.
5. Protect accepted mockups from the elements with weather resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Subject to compliance with requirements, approved mockups shall be demolished only after all masonry Work is complete.

1.10 TESTS AND INSPECTIONS

A. Materials and installation of masonry shall be subject to testing and inspection by an independent testing laboratory. Such tests and inspections shall not relieve Contractor of responsibilities for providing materials and procedures which comply with Contract Documents. Promptly remove and replace materials which do not comply.

B. Owner will select Inspection and Testing Laboratory and will pay for all Work required by Inspection and Testing Laboratory.

1.11 DELIVERY, STORAGE AND PROTECTION

A. Deliver and store materials in dry protected areas off ground. Keep free of stain or other damage before, during and after installation. Replace any damaged material at no cost to Owner.

B. During freezing weather, protect masonry units with tarpaulins or other suitable material. Keep free of stain or other damage before, during and after installation. Replace damaged material at no cost to Owner.

C. Protect reinforcement and accessories from elements.

1.12 SITE CONDITIONS

A. Cold Weather Protection:
   1. No masonry shall be laid when the temperature of the outside air is below 40 degrees F, unless protection measures are employed and pre-approved by the Architect.
   2. Protection measures for cold weather erection include maintaining space and masonry unit temperatures of at least 40 degrees F for 48 hours prior to and after erection.

B. Hot Weather Protection:
   1. When the mean daily temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 mph, fog spray all newly constructed masonry until damp, at least three (3) times a day until the masonry is three (3) days old.

1.13 BRACING OF MASONRY DURING ERECTION

A. All masonry shall be adequately braced at all times during erection.

1.14 COORDINATION

A. Openings and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry walls as required. Provide for installation of bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as required. Consult other trades in advance and make provisions for installation of their Work to avoid cutting and patching. Coordinate installation of steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

B. Contractor performing Work of this Section shall be responsible for and coordinate with work of Section 07 11 00, Dampproofing Above Grade and all Sections of Work built-in, adjacent to, or applied to unit masonry Work.

1.15 WARRANTY

A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:
1. Noticeable deterioration of unit or mortar finish.
2. Chalking or dusting excessively.
3. Changing color in irregular fashion.
4. Cracking or spalling.
5. Releasing from substrate.
6. Staining or discoloring, including efflorescence.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Must have a minimum of five (5) years experience manufacturing products equal to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
1. Face Brick Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   a. Meridian Brick.
   b. Interstate Brick.
   c. Kansas Brick and Tile.

2. Concrete Masonry Units (CMU/Block) Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   a. Best Block Construction Materials formerly known as Headwaters Concrete Products/Boral Concrete Products.
   b. Builders Products, Inc.
   c. Echelon Masonry, An Oldcastle APG Company.
   d. Innovative Precast Concrete Products (IPC)
   e. Texas Building Products, Inc.
   f. Revels Block & Brick Co., Inc.

2.2 MATERIALS

A. Concrete Masonry Units (CMU/Block):
1. Type/Sizes:
a. Concealed cavity block and interior block, unless otherwise noted: Regular smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
1) Color: As selected by Architect.

b. Exterior exposed block: Regular Smooth face units with 8 inch by 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
1) Color: As selected by Architect.

c. Interior block, unless otherwise noted: Regular smooth face units with 8 inch x 16 inch face dimensions as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.

d. Interior exposed burnished block: Integrally colored face units with 8 inch by 16 inch face dimensions with half scored partition as shown on drawings or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
1) Color: As selected by Architect..

2. Integral Water Repellant (In exterior exposed CMU): “Dry-Block Block Admixture” integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp), or equal.
3. Specification: Comply with ASTM C90 (Class D-2 (2 hour) and Class B-4 (4 hour)) block at rated walls).
a. Aggregate: Lightweight in accordance with ASTM C331.

4. Curing: Rotary kiln process.
5. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and fillers to match and compliment block units as shown or required.

B. Face Brick: Utility size face brick complying with the requirements of ASTM C216, Grade SW, Type FBX as selected by Architect, including solids and special shapes as indicated or required (all colors). Refer to Exterior Design Selections 01 60 13.

C. Cement Backer Board: Cementitious, water durable, board; surfaced with fiberglass reinforcing mesh
on front and back; long edges wrapped; and complying with ANSI A118.9 and ASTM C 1325 (PermaBase BRAND Cement Board).
1. Thickness: ½ in., 5/8 in.
2. Width: 2 ft. 8 in., 3 ft., or 4 ft.
3. Length: 4 ft., 5 ft., 6 ft., or 8 ft.
4. Edges: Tapered.
5. Compressive Strength: Not less than 2250 lbs. per sq. in. when tested in accordance with ASTM D 2394.
6. Water Absorption: Not greater than 8 percent when tested for 24 hours in accordance with ASTM C 473.

D. Fasteners:
1. Screws: Hi-Lo thread screws (No. 8) wafer head, corrosion-resistant, 1-5/8 in length , and complying with ASTM C 1002

2. Use above for wood and 22 ga. or lighter steel framing. Use below for 20 ga. or heavier steel framing.
3. Screws: Drill point screws (No. 8) wafer head, corrosion-resistant 1-5/8 in length and complying with ASTM C 1002.

E. Joint Treatment:
1. Tape: Alkali-resistant fiberglass mesh tape intended for use with cement board.

F. Adhered Masonry Veneer Installation System:
1. Basis of Design: Laticrete or approved manufacturer approved by Architect.
a. Laticrete MVIS Thin Brick Mortar (Skim Coat).
b. Laticrete MVIS Air and Water Barrier Membrane.
c. Laticrete MVIS Thin Brick Mortar (for Adhesion).
d. Laticrete MVIS Masonry Pointing Mortar.

G. Mortar:
1. Materials: (Unless stated otherwise on Structural Drawings)
a. Portland Cement: ASTM C150, Type 1.
b. Hydrated Lime: ASTM C207, TYPE “N”, typical. Use TYPE “S” for load-bearing masonry.
c. Aggregate: Sand conforming to ASTM C144.
d. Water: Clean and potable.
e. Admixtures For Mortar:
1) General: Do not use calcium chloride
2) Concrete Masonry Units: Spectrum Mortar Color or Architect approved equal.
3) Face Brick: Spectrum Mortar Color or Architect approved equal.
4) Integral Water Repellant (In mortar of exterior exposed CMU): “Dry- Block Mortar Admixture” integral water repellant admixture as manufacturer by Grace Construction Packaging (gcp) or equal. Note: Water repellent block admixture and mortar admixture are not interchangeable.

2. Mix Design: (Proportions by volume) (Unless stated otherwise on Structural Drawings)
a. Typical, Non-load bearing masonry
1) Type: ASTM C270, Type “N.”
2) Proportions: 1 part cement, 1 part hydrated lime and 6 parts sand to provide a compressive strength of 750 psi in 28 days. Do not use calcium chloride.

b. Load bearing structural masonry
1) Type: ASTM C270, Type “S.”
2) Proportions: 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide a compressive strength of 1800 psi in 28 days. Do not use calcium chloride.

H. Grout:
1. Materials: (Unless stated otherwise on Structural Drawings)
a. Hydrated Lime: ASTM C207, TYPE “S.”
b. Portland Cement: ASTM C150, Type 1.
c. Water: Clean and potable
d. Aggregates:
1) Course aggregate shall conform to ASTM C404.
2) Fine aggregate shall conform to ASTM C144.

2. Mix Design: (Unless stated otherwise on Structural Drawings)
a. Comply with ASTM C476 to provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.

1) Fine Grout: Fine grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
2) Course Grout Mix: Course grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand, and 1 to 2 parts course aggregate.

I. Reinforcement, Anchors and Tie Systems:
1. General: Reinforcement used in all wythes shall be galvanized after fabrication in accordance with ASTM A153, Class B-2.
2. Approved Manufacturers include the following:
   a. Heckmann Building Products
   b. Hohmann & Barnard, Inc
   c. Wire-Bond

3. At solid multiple wythe masonry walls and single wythe masonry walls, (Interior partitions) use #9 gauge truss type reinforcing. Pre-fab corners and tees shall be used at all wall corners and intersections; width shall be two (2) inches less than nominal thickness of walls. Hohmann & Barnard "120 Truss-Mesh" at single wythe; "230 Ladder-Tri-Mesh" at multiple, or Architect approved equal.
4. At Double Wythe Cavity Walls with Insulation Board: Use Hot-dipped galvanized, #9 gauge truss type with 3/16 inch adjustable pintle wall ties. Width of truss reinforcement shall be 2 inches less than the nominal thickness of wall. 3/16 inch wall tie double eye sections welded at 16 inches o.c. extended as required for insulation thickness. Pre fab corners and tees shall be used at all wall corners and intersections. Hohmann & Barnard, Inc. "270 Ladder Eye-Wire", or Architect approved equal.
5. At Masonry Anchored to Steel Spandrel Beam and Columns: Hot-dipped galvanized DW-10HS and V-Tie manufactured by Hohmann & Barnard, Inc. or Architect approved equal. Anchors detailed on Structural Drawings supersede.
6. At Veneer Brick Anchored to Light Gauge Steel Framing: Hot-dipped galvanized, 2 Seal Tie System utilizing self-tapping screw for steel studs with 5/8 inch barrel length, and 4 inch triangle wire tie for 2 inch cavity manufactured by Hohmann & Barnard, Inc. or Architect approved equal. Anchors detailed on structural drawings supersede. Attachment screws shall be corrosion resistant type as recommended by manufacturer to suit application. Adjust wire tie size as required to conform with cavity depth if other than 2 inch.
7. Control Joint Anchor: Equal to Hohmann & Barnard, Inc.
8. Corrugated Wall Tiles: Not acceptable under any circumstances.

J. Precast Concrete U-Lintels
1. Concrete Materials:
   a. Portland Cement: ASTM C150 Type I or III, gray color.
   b. Aggregates: ASTM C33.
   c. Water: potable
   d. Admixtures: Shall not contain calcium chloride or chloride ions

2. Reinforcing:
   a. Deformed Reinforcement: ASTM A615 Grade 40 or 60.
   b. Prestressing Strand: ASTM A416 270 ksi LL.

3. Fabrication:
   a. Unless specified otherwise, conform to PCI MNL-116.
   b. U-lintel units 14 feet in overall length and shorter shall be made of concrete with a minimum strength of 3500 psi at 28 days.
   c. U-lintel units exceeding 14 feet in overall length shall be made of concrete with a minimum strength of 6000 psi at 28 days and shall be prestressed concrete.

d. Units shall be sand block finish except prestressed, 6 inch wide, and 12 inch wide U-lintels shall be smooth form finished.
e. Tolerances shall be per PCI MNL-116
f. Minor patching in plant is acceptable provided structural adequacy of units is not impaired

4. Acceptable Product/Manufacturer: Cast-Crete High Strength Precast Concrete U-lintels as manufactured by Cast-Crete, Tampa, FL (800) 999-4641, and locally distributed by Headwaters, (713) 365-9077.

K. Block Insulation:
1. Rigid Core Inserts:
a. Type: “U” shaped insulation inserts conforming to ASTM C578, replacing Federal Specification (FS) HH-I-524C, Type I, specification for Preformed Cellular Polystyrene Thermal Insulation.
b. Sizes: As required for 6 inch, 8 inch, 10 inch, and 12 inch blocks as shown or required.
c. Approved Product/Manufacturer: Korfil Insulation Inserts manufactured by Concrete Block Insulating Systems (CBIS), West Brookfield, MA; (800) 628-8476, or Architect approved equivalent.

2. Loose Core Fill: Loose perlite or vermiculite insulation conforming to ASTM C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete, such as Zonolite manufactured by Siplast, Irving, TX; (800) 922-8800, or Architect approved equivalent. Loose fill insulation shall be certified asbestos-free.
3. Foamed-In Place Block Insulation:
a. Type: Two (2) component system consisting of amino-plast resin and a catalyst foaming agent surfactant.
b. Features:
1) Designed to completely fill irregular or hard-to-reach spaces.
2) Can be installed in both new and existing concrete masonry unit construction.
3) Excellent energy and sound insulation values.
4) No settling or expansion after installation.
5) Superior fire and safety performance.
6) No CFC’s or HFC’s.
7) Safe for the environment.
8) Approved Products/Manufacturers: “Core-Fill 500” manufactured by Tailored Chemical Products, Inc., Longview, TX; (800) 256-3626, Core Foam Masonry Foam Installation by CfiFoam; (434) 546-3632 or Architect approved equivalent.

L. Miscellaneous Materials: (As shown or required)
1. Reinforcing Steel: ASTM A615, Grade 60.
2. Forms: Form grade plywood with wood studs and wales as required.
3. Shores: Patented shores of design and manufacture sufficient to safely support imposed loads.
4. Premolded Filler: Fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751.
5. Flashing Cement: "Nerva-plast" cold setting mastic manufactured by Nervastral, Inc., or Architect approved equal.
6. Building Felt: No. 15 asphalt saturated felt, ASTM D226.
7. Dovetail Anchors: 16 gauge galvanized dovetail corrugated masonry anchor, 1 inch x 3-1/2 inch manufactured by Heckman Building Products, Inc., Hohmann & Barnard, Inc., Masonry Reinforcing Corporation of America, or Architect approved equal.

8. Steel Shapes and Plates: As shown on drawings and specified in Section 05 50 00, Metal Fabrications.
9. Headed Stud Anchor: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
10. Bolts: ASTM A307. Furnish with carbon steel washers.
11. Deformed Bar Anchors: Welded by full-fusion process as furnished by TRW Nelson Stud Welding Division, or Architect approved equal.
12. Reinforcing Bars to be Welded: ASTM A706.
13. Flashing: Reference Division 07.
14. Cavity Drainage Protection: 2 inch thick by 10 inch high by 5 feet long recycled polyester/ polyethylene mesh, trapezoidal-shaped, continuous at foundation, at heads above openings, and shelf angles as indicated on drawings. Provide Mortar Net™ manufactured by Mortar Net Solutions, Burns Harbor, IN; (800) 664-6638, or Architect approved equal.
15. Masonry Color: Iron oxide pigment conforming to ASTM C979 in color(s) selected by Architect, shall be inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, and free of fillers and extenders, as manufactured by ChemSystems, Inc., Davis Colors, Solomon Grind-Chem Service, Inc., or Architect approved equal.
16. Weep Hole Vents: Injection molded vent made from flexible polyvinyl chloride in an offset "T" shape, inserted in head joints, the slotted leg of the vent allows air to pass in and out allows water to weep out and prevents water from penetrating in manufactured by Williams-Goodco, Phone: 800-521-9594 or 248-643-6400 or Email: Wilpro@williamsproducts.net. Weep hole vents shall be sized to match masonry (may require custom sizing).

2.3 MASONRY STRENGTH

A. Ultimate compressive strength of masonry as required by design and determined by prism tests shall not be less than 2,500 psi, unless stated otherwise in Structural Drawings.

2.4 MASONRY CLEANING MATERIALS

B. Detergent Cleaner: Follow manufacturer’s instructions.

C. Proprietary Acidic Cleaner: Cleaner designed for removing mortar/grout stains, efflorescence, and construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Diedrich Technologies, Inc.
      b. PROSOCO, Inc.
      c. AHI Supply.
      d. NMD80 as manufactured by EachoChem.

C. The following products based on AHI Supply TexClean products are intended as a guide only and does not preclude the contractors use of equal products by listed manufacturers. Consult manufacturer prior to application for any questions or inconsistencies.

Substrate	Color/Type	Cleaning Solution
Brick	Red	Tex Clean Masonry Cleaner
	Light	Tex Tral Masonry Cleaner
	Dark	Tex Tral Masonry Cleaner
	Pavers	Tex Clean Masonry Cleaner
	Glazed	Tex Tral Masonry Cleaner
CMU	Split Face	Tex Tral Masonry Cleaner
	Burnished/Ground Face	Tex Tral Masonry Cleaner
Architectural Concrete	Natural Color/Smooth	Tex Tral Masonry Cleaner
	Textured	Tex Clean Masonry Cleaner
Stone Construction	Cast Stone	Tex Tral Masonry Cleaner
	Arriscraft	Tex Tral Masonry Cleaner
	Limestone (Unpolished)	Tex Tral Masonry Cleaner

PART 3 - EXECUTION

3.1 FORMS AND SHORES

A. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.

B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.

3.2 PREPARATION OF MATERIALS

A. Concrete Masonry Units:
   1. Where cutting is required, masonry shall be cut with a sharp masonry saw.
   2. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.

B. Brickwork: Dampen brick before laying in a manner consistent with the nature of the brick, the mortar, and the weather conditions.

C. Mortar and Grout:

1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable.
2. Thoroughly machine mix a minimum of five (5) minutes after all materials are in mixer.
3. Consistency will completely fill all spaces intended to receive grout.
4. Use within 2-1/2 hours of initial mixing.
5. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.

D. Reinforcement:
1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond.
2. Cut accurately to length and bend by such methods as will prevent injury to the material.
3. Straighten out kinks or bends.

E. Flashing:
1. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces.
2. Bed Joints: Coordinate Work with Division 4, Masonry. Install flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back from face of masonry.
3. Adjacent Work: Protect Work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
4. Separate copper flashing from dissimilar materials.
5. Protect membrane flashing from overexposure to direct sunlight.

3.3 INSTALLATION

A. General:
1. Do not use chipped or cracked concrete masonry units (CMU) and face brick, where exposed to view.
2. Use masonry saws to cut and fit exposed units.
3. Exposed masonry at exterior corners shall be solid units.
4. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
5. Place through-wall flashing as follows:
    a. Place on bed of mortar and cover with mortar.
    b. Provide at steel columns and beams in exterior masonry walls and elsewhere as indicated on the drawings or required.
    c. Install asphalt laminated copper membrane as base flashing at all exterior cavity walls below weep holes.
    d. Install at material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior wall sill/weep conditions, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.
6. Lay masonry units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
7. Do not furrow bed joints.
8. Stop off horizontal run by racking back in each course; toothing is not permitted.
9. Adjust units to final position while mortar is soft and plastic.
10. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh motor.
11. When joining fresh masonry to set or partially set masonry:
    a. Remove loose masonry units and mortar

b. Clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.

B. Metal Door Frames: Fill jamb frames solid with mortar. Build in anchors.

C. Lintels and Bond Beams: Provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.

D. Corners: Connect corners with No. 9 galvanized wire tie using one tie for each 4 inches of nominal wall thickness.

E. Partition Tops: Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Sealant section. Anchor top of walls to deck or structure.

F. Mortar Beds:
1. Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
2. Lay units with full mortar coverage on horizontal and vertical joints in all courses.
3. Provide sufficient mortar on ends of masonry unit to fill head joints.
4. Rock closures into place with head joints thrown against two adjacent masonry units in place.
5. Do not pound corners or jambs to fit stretcher units after setting in place.
6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.

G. Mortar Joints and Patterns:
1. Lay CMU in running one-half (1/2) bond pattern, unless noted otherwise.
2. Lay brick in running one-third (1/3) bond pattern, unless noted otherwise on drawings. Refer to drawings for accent coursing.
3. Provide flush joints where concealed from view and where dampproofing is scheduled.
4. Provide standard concave tooled joint where masonry is exposed to view for brick and CMU, typically.
5. All mortar joints to be of consistent size.
6. Provide soldier courses where indicated, refer to the elevations.
7. All horizontal joints shall be concave tooled joint at face of units, unless noted otherwise.
8. Provide raked joints at all exposed burnished cmu locations.

H. Reinforcement, Anchor and Tie Systems:
1. General:
   a. Completely embedded in mortar or grout.
   b. All reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have no less than 5/8 inch mortar coverage from the exposed face.
   c. Where modular brick is used with brick coursing at 16 inches on center, provide ladder reinforcing within each wythe at 16 inches o.c. vertically for exterior wythe and back-up wythe, whether detailed or not. For other than modular brick, refer to Paragraph h. below.
   d. Veneer anchors at exterior sheathed covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws. Spacing shall be same as stud spacing o.c. horizontally and 16 inches o.c. vertically.
   e. Veneer anchors at Interior brick walls with metal stud back-up shall be the same as Paragraph “d” above, except anchors shall be attached directly to metal stud with recommended corrosion resistant fasteners in accordance with manufacturer’s recommendations.

f. At intersection of all perpendicular masonry walls provide two (2) vertical rows of ladder type reinforcing at 16 inches o.c. vertically. Refer to Structural Drawings for details on shear walls.
g. Weld veneer anchors to structural steel in accordance with manufacturer's recommendations. Touch-up steel shop paint and galvanized coating on anchor with touch-up primer and finish coats to match damaged coating in accordance with manufacturer's recommendations.
h. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.
i. Splices in reinforcement: Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall be eight (8) inches. Welded or mechanical connection shall develop the strength of the reinforcement.
j. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions are acceptable.
k. Place joint reinforcement in the first two (2) bed joints above and the first two (2) bed joints below masonry openings. Extend extra reinforcing two (2) feet beyond jambs.
l. Provide masonry ties at floor and roof decks as indicated.

I. Flashing:
1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
2. Application Guidelines - Install flashing at the following locations:
a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill/weep conditions, exterior door and window head/weep conditions, masonry wall cap flashing and masonry wall base flashing.

3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
4. Provide drip edge flashing at weep conditions with membrane flashing. Cut membrane flush with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where

possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.

9. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
10. Heads and Sills: Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weepholes.
11. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
12. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
13. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
14. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
15. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
16. Reglet Termination: Insert wedge into place and seal carefully with adhesive
17. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
18. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.

J. Laying Masonry: Lay units plumb, level, and true to line with full head and bed joints. Butter ends of masonry with sufficient mortar to fill head joints. Do not furrow bed joints. Slope top of bed joint toward center of wall to minimize amount of mortar forced into grout space. Remove mortar, protruding from joints into grout space, before pouring grout.

K. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding eight 8 feet-0 inches with a minimum clearance of 1/4 inch from masonry and not less than one (1) bar diameter between bars.
2. When a foundation dowel is not in alignment with a vertical block cell or pilaster, slope it not more than one (1) horizontal in six (6) vertical to bring it into proper alignment before grouting.
3. Place horizontal reinforcing bars in continuous masonry courses, consisting of bond-beam or trough block units, and solidly grout in place.
4. Use straight reinforcing bars except for bends around corners and where bends or hooks are detailed on plans.
5. Lap reinforcing steel 40 bar diameters minimum where spliced and wire together.

L. Grouting: Where detailed place grout in reinforced masonry beams, walls, columns, and pilasters. All cells and spaces containing reinforcing bars shall be filled with grout. Wherever

possible grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.

1. Prior to grouting clean space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material. Grout shall be placed so all spaces designated to be grouted shall be filled with grout and grout shall be confined to those specific spaces.
2. Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation of constituents and shall be mixed thoroughly.
3. Between grout pours a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with grout stopping a minimum of 1-1/2 inches below a mortar joint, except at top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below top of masonry.
4. Reinforcement shall be placed prior to grouting. Bolts shall be accurately set with templates or by approved equivalent means and held in place to prevent movement.
5. Segregation of grout materials and damage to masonry shall be avoided during the grouting process. Adequately brace masonry to prevent displacement or cracking during grouting operations.
6. Grout shall be consolidated by mechanical vibrator during placing, before loss of plasticity, in a manner to fill grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated, or puddled.
7. Grout shall not be handled nor pumped utilizing aluminum equipment.
8. Size and height limitations of grout space or cell shall be as follows:

GROUT TYPE	GROUT POUR MAX. HEIGHT (FEET)	LEAST CLEAR DIMENSIONS		CLEANOUTS REQUIRED
		Width of Grout Space (In.)	CMU Cell Dim. Dims. (In. x In.)	
Fine	1	3/4	1-1/2 x 2	No
Fine	5	1-1/2	1-1/2 x 2	No
Fine	8	1-1/2	1-1/2 x 3	Yes
Coarse	1	1-1/2	1-1/2 x 3	No
Coarse	5	2	2-1/2 x 3	No
Coarse	8	2	3 x 3	Yes

   a. Clear dimension is the cell or grout space width less mortar projections.
   b. Grout space width shall be increased by the horizontal projection of the diameters of horizontal bars within the cross section of the grout space.

9. Place grout in lifts not exceeding 8 feet-0 inches.

M. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report discrepancies or procedures which may adversely affect performance of masonry Work.

N. Brick Weep holes:
1. Provide weep holes above all thru-wall flashings where weep holes occur at the base of the wall. The mason shall coordinate the location of the thru-wall flashings with the location of the sidewalks on the civil engineering drawings. All weep holes shall be at least one course below finished floor or at the first course of brick above the sidewalks. Pay particular attention to areas near exterior doors.
2. Ensure cavity drainage protection is properly installed.

3. Leave head joint free and clean of mortar.
4. Spacing: 20 inches on center maximum for king sized brick, and 24 inches on center for modular brick and block, unless shown otherwise.
5. Keep weep holes and area above flashing free of mortar droppings.
6. Coordinate weep holes to be located above sidewalks and paving.

O. Sealant Joints:
1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings.
2. Uniform depth: 3/4 inch.
3. Uniform width: As shown on the drawings but not less than 1/4 inch.
4. Provide sample for Architect's approval.
5. Refers to drawing for locations and details of accent joints.

P. Movement Joints (Expansion Joints and Control Joints):
1. Locate expansion and control joints as shown on drawings, or if not shown, comply with the following:
   a. General:
      1) Vertical expansion joints shall be placed in the brick wythe and control joints shall be placed in the concrete masonry wythe, although they do not necessarily have to be aligned.
      2) Mortar and joint reinforcement shall not bridge brick movement joints.
      3) Mortar joints which stop at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.

   b. Vertical Expansion Joints:
      1) Locate expansion joints on long straight walls without openings maximum 25 feet-0 inches.
      2) Locate expansion joints at the corner of walls perpendicular to one another. In instances, where the joint is not desired at the corner, the expansion joint shall be located within 10 feet-0 inches of the corner in either wall, but not necessarily both. The spacing of expansion joints around a corner shall not exceed the spacing of expansion joints in a straight wall. For example, if the spacing between expansion joints on a straight wall is 25 feet-0 inches, then the spacing of expansion joints around a corner could be 10 feet-0 inches on one side of the corner and 15 feet-0 inches on the other side. Joint reinforcement may be added around wall corners to provide added tensile strength to the corner, but joint reinforcement shall not bridge the expansion joint.

   c. Offsets and Setbacks:
      1) Locate expansion joints at 10 feet-0 inches maximum on one side of the offset or setback. The spacing of expansion joints around an offset or setback shall not exceed the spacing of expansion joints in a straight wall. See expansion joints at corners of perpendicular walls to one another above for example of spacing.

   d. Openings (Doors and Windows):
      1) Locate vertical expansion joints along the edge or jamb of the opening of windows and doors. Single opening windows and doors under 6 feet-0 inches in width shall have expansion joint on one (1) side of the edge or jamb of the opening as determined by the Architect, unless shown otherwise on drawings. Windows and doors 6 feet-0 inches and over in

width shall have expansion joints on both sides of the edge or jamb of the opening.

2) Where masonry above an opening is supported by shelf angles attached to the structure, a vertical expansion joint shall be located alongside the opening, continuing through the horizontal support.

3) Where masonry above the opening is supported by loose lintels (unattached to the structure), special detailing and construction is required. If the expansion joint runs along side the opening, the loose steel lintel shall be allowed to expand independently of the masonry. To accomplish this, form a slip plane with flashing located above and below the angle. A backer rod and sealant shall be installed in front of the toe of the angle, and space shall be left at the end of the angle. Thus, a pocket will be formed which will allow movement of the steel angle within the brickwork. If the joint cannot be built in this manner, then the vertical expansion joint shall not be located alongside the opening, but rather, with Architect's prior approval, the joint shall be located halfway between the openings.

e. Intersections and Junctions:

1) Locate expansion joints at intersections of masonry walls and walls which serve different functions. If the masonry is not required to be bonded at the intersection, an expansion joint shall be incorporated. Walls which intersect at other than right angles are also vulnerable to cracking at the intersection.

2) Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.

f. Parapets:

1) All vertical expansion joints shall be carried through the parapets.

2) Additional expansion joints shall be halfway between those running full height, unless the parapet is reinforced. These additional expansion joints shall continue down to a horizontal expansion joint, or continue to the base of the wall.

g. Horizontal Expansion Joints:

1) Locate horizontal expansion joints at shelf angles supporting brick masonry.

h. Control Joints:

1) Locate CMU control joints directly over concrete slab control joints.

2) Whenever possible, lay out CMU so that control joint will coincide with CMU module (25 feet-0 inch maximum spacing between control joints), unless noted otherwise on drawings.

3) Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns.

4) Install backer rod and sealant in accordance with manufacturer's instructions.

3.4 ALLOWABLE TOLERANCES

A. Maximum Variation from Plumb:

1. In lines and surfaces of columns, walls and at rises:
   a. 1/4 inch in 10 feet (1:480).
   b. 3/8 inch in 20 feet (maximum).
   c. 1/2 inch in 40 feet (1:960).

2. For external corners, expansion joints and other conspicuous lines:
   a. 1/4 inch in 20 feet (maximum).
   b. 1/2 inch in 40 feet (1:960).

B. Maximum variation from level:
   1. 1/4 inch in any bay or 20 feet.
   2. 1/2 inch in 40 feet (1:960).

3.5 REMOVAL OF FORMS AND SHORES

A. Do not remove shores and forms under reinforced masonry beams, lintels, and soffits until members have hardened sufficiently to carry their own weight and other super imposed loads. Providing that sufficient curing has taken place, leave forms and shores in place as follows:
   1. Beam and lintels: Minimum ten (10) days.

B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads on them. Allow an additional 48 hours before applying concentrated loads such as trusses, girders, and beams.

3.6 REPAIRING, POINTING AND CLEANING

A. All holes in exposed masonry shall be pointed, and defective joints shall be cut out and re-pointed with mortar.

B. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet, in a location approved by Architect. No further cleaning Work may proceed until the sample area has been approved by Architect, after which, the same cleaning materials and method shall be used on remaining wall area. Sash, metal lintels and other corrodible parts shall be thoroughly protected.
Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.
   1. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
   2. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
   3. Mix materials in strict accordance with manufacturers instructions; do not dilute unless permitted by manufacturer.
   4. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
   5. No high pressure washers are permitted.
   6. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
   7. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

3.7 REPAIR OR REPLACEMENT OF DAMAGED WORK

A. Imperfect or damaged Work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at Contractor's expense and in conformity with all requirements of drawings and specifications. Removal and replacement of masonry Work shall be performed in such a manner as not to impair the appearance or strength of the structure in any way.

3.8 CLEAN-UP AND PROTECTION

A. Clean up all debris caused by Work of this Section, keeping the area clean and neat at all times.

B. Cover all unfinished Work at night against the elements with plastic sheeting, building paper, heavy canvas or other material approved by Architect to prevent water from entering cavities.

C. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

3.9 FIELD QUALITY CONTROL AND TESTING

A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

END OF SECTION 04 20 00

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:
1. Decorative CMUs, in the form of small-scale units.
2. Pre-faced CMUs.
3. Colored mortar.
4. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:
1. CMUs.
2. Accessories embedded in masonry.

1.7 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:
1. Masonry units.
   a. Include material test reports substantiating compliance with requirements.
   b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
1. Build sample panels for each type of unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Protect approved sample panels from the elements with weather-resistant membrane.
4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. CMUs: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,000 psi.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

E. Masonry Cement: ASTM C 91.

F. Mortar Cement: ASTM C 1329.

G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

H. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints, less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C 404.

J. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.

L. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.
   1. Interior Walls: Mill- galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized, carbon steel.
   3. Wire Size for Side Rods: 0.148-inch diameter or as indicated on Drawings.
   4. Wire Size for Cross Rods: 0.148-inch diameter or as indicated on Drawings.
   5. Wire Size for Veneer Ties: 0.148-inch diameter or as indicated on Drawings.
   6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units].

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
   2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, with ASTM A 153, Class B coating.
   3. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
   2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel.

C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
   2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel.
   3. Corrugated Metal Ties: Metal strips not less than 7/8-inch-wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.075-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.

D. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4-inch-thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
   1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153] [Epoxy coating 0.020 inch thick.

2.7 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.

B. Post-installed Anchors: Torque-controlled expansion anchors or chemical/adhesive anchors unless otherwise indicated on Drawings.
   1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as indicated on Drawings. Include accessories, adhesives, primers, and seam tapes as applicable.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
      b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
      c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
      d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.

2. For reinforced masonry, use Portland cement-lime mortar.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or] paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi except where indicated on Drawings.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch or minus 1/4-inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.

B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10 feet, 3/8-inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus 1/4-inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, unless otherwise indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches or less on center unless otherwise indicated.
   3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
   3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
   1. Provide an open space not less than inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Structural steel.
2. Prefabricated building columns.

B. Related Sections:
1. Section 01 45 23 "Testing and Inspection Services".
2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
3. Section 05 31 00 "Steel Decking".
4. Section 13 34 19 "Metal Building Systems".

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCES

A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. AISC "Code of Standard Practice for Steel Buildings and Bridges”.
2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.
3. AISC "Specification for Architecturally Exposed Structural Steel”.
4. AISC's "Seismic Provisions for Structural Steel Buildings”.

5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".
6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.5 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.

B. Moment Connections: Type FR, fully restrained.

C. Construction: System as indicated on Drawings.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.
8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Submit the following informational submittals:

1. Qualification Data: For qualified installer, fabricator, and testing agency.
2. Welding certificates.
3. Mill test reports for structural steel, including chemical and physical properties.
4. Product Test Reports: For the following:
   a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   b. Direct-tension indicators.
   c. Tension-control, high-strength bolt-nut-washer assemblies.
   d. Shear stud connectors.
   e. Shop primers.
5. Source quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
1. W-Shapes: 60 percent.
2. Channels, Angles, M, S-Shapes: 60 percent.
3. Plate and Bar: 25 percent.
4. Cold-Formed Hollow Structural Sections: 25 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

B. W-Shapes: Refer Structural General Notes.

C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.

D. Plate and Bar: Refer Structural General Notes.

E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.

F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.

G. Steel Pipe: Refer Structural General Notes.
1. Weight Class: See Plans.
2. Finish: Black except where indicated to be galvanized.

H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain or Mechanically deposited zinc coating, where required.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
   1. Configuration: Straight.
   2. Nuts: ASTM A 563 heavy-hex carbon steel.
   3. Plate Washers: ASTM A 36 carbon steel.
   4. Washers: ASTM F 436, Type 1, hardened carbon steel.
   5. Finish:
      a. General Condition – Plain
      b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.

F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Amscot Structural Products Corp.
      b. Fluorocarbon Company Limited.
      c. R.J. Watson Bridge & Structural Engineered Systems.
      d. Seismic Energy Products, L.P.
   2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
   3. Coefficient of Friction: Not more than 0.05.
   4. Design Load: Not less than 5,000 psi .
   5. Total Movement Capability: 2 inches.

2.3 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.

D. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

A. Refer Section 03 30 00.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
   1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
   2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
   3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
   4. Camber tolerance
      a. Beams 50 feet and less; plus or minus 1/2 inch.
      b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
      c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
   5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
   6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.
1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.

I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
3. Bolts over 1 3/4 inch diameter: 1 inch oversize.

J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick
5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick

K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.

3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.

F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

G. GALVANIZING

H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Refer Section 01 45 23.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: See Section 01 45 23.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 21 00 – STEEL OPEN WEB JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH- and DLH-series long-span steel joists.
5. CJ-series composite steel joists.
6. Joist girders.
7. Joist accessories.
8. Extended ends.
9. Ceiling extensions.
10. Bearing plates.
11. Bridging.
12. Side wall anchors.

B. Related Requirements:
1. Section 03 30 00 "Cast-in-Place Concrete".
2. Section 01 45 23 “Testing and Inspection Services”
3. Section 04 20 00 "Unit Masonry".
4. Section 05 12 00 "Structural Steel Framing".
5. Section 05 31 13 “Steel Floor Decking”.
6. Section 05 31 23 “Steel Roof Decking”.

1.3 REFERENCES

A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.

B. AWS D1.1 Structural Welding Code

C. SJI “Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders”.

D. SDI “Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution”.

E. SSPC Steel Structures Painting Council Painting Manual.

F. UL Fire Resistance Directory.

G. ICBO Product Evaluation Reports.

H. FM Roof Assembly Classifications.

I. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.
Review LEED requirements with Project Architect and edit as needed. References to LEED credits below MAY NOT be current.

B. Shop Drawings:
1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.
4. Shop drawings containing special joists shall be submitted with a design load summary for each special joist design. Load summary will be reviewed and returned with the joist submittal. Shop drawings containing special joists submitted without the specified load summary will be returned unchecked as an incomplete submittal. Shop drawings containing special joists shall be signed and sealed by the qualified professional engineer responsible for the design of the joists.

1.6 INFORMATIONAL SUBMITTALS

A. Submit the following informational submittals:
1. Qualification Data: For manufacturer.
2. Welding certificates.
3. Manufacturer certificates.
4. Mill Certificates: For each type of bolt.
5. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

B. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.9 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and or masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

B. Use ASD; data are given at service-load level.

C. Design special joists to withstand design loads with live-load deflections no greater than the following:
1. Floor Joists: Vertical deflection of 1/360 of the span.
2. Roof Joists: Vertical deflection of 1/360 of the span.

D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.2 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions and Extended Ends: Provide top chord extension or extended ends where shown on plans. Design for load indicated on plans.

E. Camber joists according to SJI's Specifications unless noted otherwise.

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on plan.

1. Joist Type: Refer to Drawings.
2. End Arrangement: Refer to Drawings.
3. Top-Chord Arrangement: Refer to Drawings.

B. Provide holes in chord members for connecting and securing other construction to joists.

C. Camber long-span steel joists according to SJI's Specifications unless noted otherwise.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on plan.
1. End Arrangement: Refer to Drawings.
2. Top-Chord Arrangement: Refer to Drawings.

B. Provide holes in chord members for connecting and securing other construction to joist girders.

C. Camber joist girders according to SJI's Specifications unless noted otherwise.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.6 PRIMERS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.7 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint for interior exposure or Hot-dip zinc coat according to ASTM A 123/A 123M for exterior or weather exposure.

C. Furnish ceiling extensions (where indicated), either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

D. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

Finish: Plain, uncoated.

E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish: Plain.

F. Welding Electrodes: Comply with AWS standards.

G. Galvanizing Repair Paint: ASTM A 780.

H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.8 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 2 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.

C. Before installation, splice joists delivered to Project site in more than one piece.
Space, adjust, and align joists accurately in location before permanently fastening.

D. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

E. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

F. Field weld joists to supporting steel bearing plates and framework as indicated on Drawings. Coordinate welding sequence and procedure with placement of joists. Comply with AWS

requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.

G. Bolt joists to supporting steel framework using high-strength structural bolts as indicated on Drawings. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: See Section 01 45 23.

3.4 REPAIR AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

C. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.

1. Apply a compatible primer of same type as primer used on adjacent surfaces.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

SECTION 05 31 13 - STEEL FLOOR DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Composite floor deck.
2. Electrified cellular floor deck.
3. Noncomposite form deck.
4. Noncomposite vented form deck.

B. Related Requirements:
1. Section 01 45 23 “Testing and Inspection Services”.
2. Section 03 30 00 "Cast-in-Place Concrete".
3. Section 05 12 00 "Structural Steel Framing".
4. Section 05 21 00 “Steel Joist Framing”

1.3 REFERENCES

A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. AWS D1.1 - Structural Welding Code
2. AWS D1.3 – Structural Welding Code – Sheet Steel
3. SDI – Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution.
4. SSPC – Painting Manual
5. UL – Fire Resistance Directory
6. ICBO – Product Evaluation Reports

1.4 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Submit the following informational submittals:
1. Welding certificates.
2. Product Certificates: For each type of steel deck.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
4. Power-actuated mechanical fasteners.
5. Evaluation Reports: For steel deck.
6. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer Section 01 45 23.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Verco Manufacturing Co.
13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized-Steel Sheet: As indicated in Structural General Notes.
   2. Profile Depth: As indicated on plan.
   3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
   4. Span Condition: Triple span or more.

2.3 ELECTRIFIED CELLULAR FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. CMC Joist & Deck.
   2. Consolidated Systems, Inc.; Metal Dek Group.
   3. Cordeck.
   4. HH Robertson Floor Systems; a CENTRIA company.
   5. Marlyn Steel Decks, Inc.
   6. New Millennium Building Systems, LLC.
   7. Nucor Corp.; Vulcraft Group.
   8. Verco Manufacturing Co.
   9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

C. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from single manufacturer.

D. Electrified Cellular Floor Deck: Fabricate steel-sheet cellular floor-deck panels, consisting of a ribbed top section welded to a lower flat-bottom sheet with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck" in SDI Publication No. 31. Fabricate deck to the minimum section properties, width of panel, number and area of cells per panel indicated, and the following:
   1. Cellular Deck Type: Composite.
   2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.
   3. Profile Depth: As indicated on plan.
   4. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
   5. Span Condition: Triple span or more.
   6. Factory punch holes, of size and arrangement indicated, into each deck cell at preset inserts and header duct locations.

2.4 NONCOMPOSITE FORM DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   3. CMC Joist & Deck.
   4. Consolidated Systems, Inc.; Metal Dek Group.
   5. Cordeck.
   6. DACS, Inc.

7. Marlyn Steel Decks, Inc.
8. New Millennium Building Systems, LLC.
9. Nucor Corp.; Vulcraft Group.
10. Roof Deck, Inc.
11. Valley Joist; Subsidiary of EBSCO Industries, Inc.
12. Verco Manufacturing Co.
13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 80 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard Gray.
2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G90 zinc coating.
3. Profile Depth: As indicated on Plan.
4. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.5 NONCOMPOSITE VENTED FORM DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Roof Deck, Inc.
9. Verco Manufacturing Co.
10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Noncomposite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G60 zinc coating.
2. Profile Depth: As indicated on Plan.
3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
4. Span Condition: Triple span or more.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.
6. Vent Slot Area: Manufacturer's standard vent slots providing 1.5 percent open area.

2.6 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated on Drawings.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: ASTM A 780.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 3/4 inch, nominal.
2. Weld Spacing: Space and locate welds as indicated on Drawings.
3. Weld Washers: Install weld washers at each weld location where deck is 22 gage or less.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch only with concrete filled decks.
3. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Revise "Floor-Deck Closures" Paragraph below to suit Project. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from units indicated.
1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.

G. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.4 COMPOSITE FLOOR DECK INSTALLATION

A. The composite steel deck shall be connected to the supporting steel beams by welding the shear/headed stud connectors through the deck as indicated in the drawings. Contractor to verify the attachment of the deck to the supporting member after the headed stud is welded. Improper amperage may cause burn through around the stud and the deck may not be adequately attached to the supporting deck.

B. Where shear/headed stud connectors are not specified, the metal deck shall be attached to the supporting steel with 3/4-inch diameter puddle welds at a maximum spacing of 12 inches.

C. Where the specified shear/headed stud connector spacing exceeds 12 inches, provide 3/4-inch diameter puddle welds between shear/headed stud connectors to maintain a maximum deck connection of 12 inches.

D. Where deck units abut side to side or end to end over a supporting member provide 3/4-inch diameter puddle welds on each deck unit at a maximum spacing of 12 inches.

E. Shear/Headed Stud Connectors: Field weld shear/headed stud connectors through deck to supporting frame according to AWS D1.1 and manufacturer’s written instructions. Located connectors as indicated in the drawings. Remove and discard arc shields after welding shear/headed stud connectors.

3.5 DECK AND FLOOR DEFLECTION

A. The metal deck is designed to deflect up to 3/4-inch.

B. Uncambered steel beams are designed to be within code required deflection limits (Span/240). Cambered steel beams are designed to have a final deflected shape of less than 1/2-inch. Due to field tolerances and camber tolerances, these design limits may be slightly exceeded.

C. The contractor shall account for any additional concrete required due to these deflected shape tolerances.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Refer Section 01 45 23.

B. Remove and replace work that does not comply with specified requirements.

C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 31 23 - STEEL ROOF DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Roof deck.
2. Acoustical roof deck.
3. Noncomposite vented roof deck.

B. Related Requirements:
1. Section 01 45 23 “Testing and Inspection Services”
2. Section 05 12 00 "Structural Steel Framing".

1.3 REFERENCES

A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. AWS D1.1 – Structural Welding Code
2. AWS D1.3 – Structural Welding Code – Sheet Steel
3. SDI – Design Manual
4. SSPC – Painting Manual
5. UL – Fire Resistance Directory
6. ICBO – Product Evaluation Reports
7. FM – Roof Assembly Classifications

B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
1. Power-actuated mechanical fasteners.

2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer Section 01 45 23.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.

5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard.
2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard.
4. Deck Profile: As indicated on plan.
5. Profile Depth: As indicated on plan.
6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard.
2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
3. Deck Profile: As indicated in Structural General Notes.

4. Cellular Deck Profile: As indicated in Structural General Notes.
5. Profile Depth: As indicated in Structural General Notes.
6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
11. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
    a. Factory install sound-absorbing insulation into cells of cellular deck.

2.4 NONCOMPOSITE VENTED ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Roof Deck, Inc.
9. Verco Manufacturing Co.
10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Noncomposite Vented Roof Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
2. Profile Depth: As indicated in Structural General Notes.
3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
4. Span Condition: Triple span or more.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.
6. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2.

2.5 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780.

L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
1. Fasteners shall provide diaphragm shear and uplift resistance equal to or greater than welding indicated herein and on Drawings.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
1. Weld Diameter: As indicated on Structural Plans.
2. Weld Spacing: As indicated on Structural Plans.
3. Weld Washers: Install weld washers at each weld location if deck gauge is lighter than 22 gauge.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals shown on Structural Plans:
1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: See Section 01 45 23.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 51 00 - STEEL STAIRS, HANDRAILS, AND RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Preassembled steel stairs.
2. Treads, concrete filled and steel.
3. Steel tube handrails and railings.
4. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of steel stairs and railings to design stairs and railings.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
   b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.5.

1.5 SUBMITTALS

A. Product Data: Technical data for metal pan stairs and the following:
   1. Prefilled metal pan stair treads.
   2. Precast concrete treads.
   3. Nonslip aggregates and nonslip aggregate finishes.
   4. Abrasive nosings.
   5. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type and finish of nosing and tread.

D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Welding Qualifications: Qualify procedures and personnel according to the following:
      a. AWS D1.1/D1.1M Structural Welding Code - Steel.
      b. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.

B. Installer Qualifications: Fabricator of products, having minimum of 5 years documented experience in the fabrication and installation of metal stairs.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
   1. Alfab, Inc.
   2. American Stair, Inc.
   3. Lapeyre Stair Inc.

4. Pacific Stair Corporation.
5. Worthington Metal Fabricators.

B. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

F. Uncoated, Cold Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

G. Uncoated, Hot Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

H. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

I. Expanded Metal, Carbon Steel: ASTM F 1267, Class 1 (uncoated).

J. Perforated Metal: Cold rolled steel sheet, ASTM A 1008/A 1008M, or hot rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B.

K. Perforated Metal: Galvanized steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B.

L. Woven Wire Mesh: Intermediate crimp, 2 inch (50 mm) woven wire mesh, made from 0.135 inch (3.5 mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

M. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

N. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

O. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).

P. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

Q. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

R. Abrasive Nosings
1. Cast Metal Units: Cast aluminum, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
      1) American Safety Tread Co., Inc.
      2) Barry Pattern & Foundry Co., Inc.
      3) Granite State Casting Co.

4) Nystrom, Inc.
5) Safe-T-Metal Company, Inc.
6) Wooster Products Inc.

b. Configuration: Cross-hatched units, 3 inches (75 mm) wide without lip.
c. Thickness: 3/8 inch.

2. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
      1) ACL Industries, Inc.
      2) American Safety Tread Co., Inc.
      3) Amstep Products.
      4) Armstrong Products, Inc.
      5) Granite State Casting Co.
      6) Nystrom, Inc.
      7) Wooster Products Inc.

   b. Provide solid abrasive type units without ribs.
   c. Thickness: 3/8 inch.

3. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
4. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
5. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

S. Fasteners: Provide zinc plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
   1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
   2. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
      a. Provide mechanically deposited or hot dip, zinc coated anchor bolts.

   3. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
      a. Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

T. Miscellaneous Materials:
   1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company or comparable product approved by Architect.
   2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.

3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D 1187 ASTM D 1187/D 1187M.
7. Concrete Materials and Properties: Comply with requirements in Section 033000 for normal weight, air entrained, ready mix concrete with a minimum 28 day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
8. Nonslip Aggregate Concrete Finish: Factory packaged abrasive aggregate made from fused, aluminum oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
9. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

U. Precast Concrete Treads:
1. Concrete Materials and Properties: Comply with requirements in Section 033000 for normal weight, ready mixed concrete with a minimum 28 day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.
2. Reinforcement: Galvanized, welded wire reinforcement, 2 inches by 2 inches (50 mm by 50 mm) by 0.062 inch (1.6 mm) diameter wire; comply with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

2.2 FABRICATION

A. Provide complete stair assemblies, including metal framing, hangers, struts,[**railings,**] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.3 STEEL FRAMED STAIRS

A. NAAMM Stair Standard: Comply with *Recommended Voluntary Minimum Standards for Fixed Metal Stairs* in NAAMM AMP 510 *Metal Stairs Manual*, unless more stringent requirements are indicated.

B. Stair Framing:
1. Fabricate stringers of steel plates or channels.
   a. Provide closures for exposed ends of channel stringers.
2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board shaft wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire resistance rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
1. Steel Sheet: Uncoated **cold** rolled steel sheet unless otherwise indicated.
2. Steel Sheet: Galvanized steel sheet, where indicated.
3. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
5. Shape metal pans to include nosing integral with riser.
6. Attach abrasive nosings to risers.
7. Provide subplatforms of configuration the same as subtreads. Weld subplatforms to platform framing.
   a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.4 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: 1-5/8 inch (41 mm) diameter top and bottom rails and 1-1/2 inch (38 mm) square posts.
2. Picket Infill: 1/2 inch (13 mm) square pickets spaced less than 4 inches (100 mm) clear.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
1. Finish welds to comply with NOMMA *Voluntary Joint Finish Standards*" for Type 1 welds: no evidence of a welded joint as shown in NAAMM AMP 521.

C. Form changes in direction of railings:
   1. By flush bends or by inserting prefabricated flush elbow fittings.

D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Connect posts to stair framing by direct welding unless otherwise indicated.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
   1. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous metal components.
   2. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt that provides 1-1/2 inch (38 mm) clearance from inside face of handrail to finished wall surface.

I. Fillers: Provide fillers made from steel plate, or other suitably crush resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.5 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   2. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 *Power Tool Cleaning*.

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

A. Fastening to In Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

G. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
   1. Anchor posts to steel by welding to steel supporting members.
   2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Locate brackets at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.
   3. For steel framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 51 00

SECTION 05 51 33.33 - ALUMINUM SHIPS LADDER

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Provide aluminum ships ladder, including ladder, handrail designed to be permanently attached top and bottom in locations shown on drawings.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specification and technical data.
   2. Manufacturer’s installation instructions.

B. Shop Drawings: Indicate size, material, and finish. Show location and installation procedures. Include details of joints, attachments, and clearances.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Examine ladder when it arrives on site. Notify the carrier and manufacturer of any damage.

B. Store ladder until installation under roof, if possible; or, if stored outside, under a tarp or suitable cover.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER/PRODUCT

A. Specifications are based on Model SL manufactured by PRECISION Ladders, LLC, Morristown, TN; (800)225-7814. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 01 regarding substitutions to be considered.

2.2 MATERIALS

A. Ladder:
   1. Stringers (Siderails): 6005-T5 aluminum channel 5 inches by 2 inches by 3/16 inch.
   2. Treads: 6005-T5 aluminum channel 5-3/16 inch by 2 feet-2 inches. Deeply serrated aluminum channel treads (standard) both welded and bolted to stringer.
   3. Mounting Bracket:
      a. Floor: 2 inch x 3 inch x 1/4 inch aluminum angle.
      b. Top: 4-3/4 inch x 2 inch aluminum 5 inch angle.

B. Handrail:
   1. 1-1/4 inch Schedule 40 6061 T-6 aluminum pipe.
   2. Internal aluminum fittings.

3. Provide handrail safety extension. Modify in field to fit conditions.

C. Finish: Mill finish on aluminum components.

2.3 FABRICATION

A. General: Fabricate ladders and handrails to conform with construction requirements and in accordance with approved shop drawings.

B. Ladder shall be completely fabricated ready for installation before shipment to the site.

C. Handrail components shall be completely fabricated ready for field assembly to the ladder before shipment to the site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordination: Coordinate start and installation of ladders with all other related and adjacent work. Installation shall not start until conditions and construction to which ladders are to be attached and secured are ready to receive work.

B. Verification: Verify that dimensions and angle(s) are correct and that substrate is in proper condition for ladder installation. Do not proceed to install until all necessary corrections have been made.

3.2 INSTALLATION

A. Install at locations shown on drawings.

B. Install in accordance with manufacturer's printed instructions.

3.3 CLEANING

A. Clean work area of debris.

B. Clean exposed surfaces of ladders of dirt, grease and other foreign materials detrimental to good appearance.

END OF SECTION 05 51 33.33

SECTION 05 51 36 – METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 REFERENCES

A. Conform to the following reference standards as applicable to the Work:
   1. American Institute of Steel Construction (AISC).
   2. American Iron and Steel Institute (AISI).
   3. American Welding Society (AWS).

1.3 SUBMITTALS

A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Shop Drawings:
   1. Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
   2. Submit design calculations for the materials and their connections designed by the Contractor, prior to or with the shop drawings. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Shop drawings containing connections for which calculations have not been received will be returned unchecked as an incomplete submittal. Design Calculations will be retained for the Architect's file, and will not be approved or returned.

1.4 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.5 WARRANTY

A. Warrant the Work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: JOMY Staircases/Counter Balanced Stairs. Other manufacturers shall have a minimum of ten (10) years experience and employ a licensed engineer to design these stairs.

2.3 COUNTERBALANCED STAIRS

A. Composition and Materials: Staircase and platforms are made of extruded aluminum sections formed from 6061-T5 and 6063-T6 alloy. Tubular balusters are formed from 6005-T5 and T6 alloy. Attachment hardware including expansion bolts and pop-rivets are stainless steel.. Pivot for the counter-balanced stairs shall be a stainless steel rod of 25/32nd inch inside two-inch

nylon bushings. Counter-balanced arms are constructed from aluminum channel with a stainless steel cover, filled with lead weights equivalent to stair weight, and attached to the stair stringer with stainless steel bolts.

B. Stairways shall support the dead load plus a live load of not less than 100 pounds per square foot (4.79 kN/m2) and shall be provided with a guard rail. All stair guard railings shall support a horizontal force of not less than 50 pounds per lineal foot (729.5 N/m) of railing.

C. Pickets and rails shall be configured such that a 4" diameter sphere cannot pass through, except at triangular openings formed by riser, tread and rail which shall not permit a 6" diameter sphere to pass.

D. The rise of the steps shall be not less than 4 inches ((102 mm) nor greater than 10 inches (254 mm). Treads shall be 10 inches (254 mm) in depth.

E. Handrails, if specified, may project into the required width a distance of 3 1/2 inches (89 mm) from each side of stairway.

F. Color: As selected by architect from Manufacturer’s full range.

G. Size: Refer to Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall furnish and install the counter-balanced stairs where indicated on the architectural/engineering drawings. To ensure satisfactory performance, the manufacturer’s installation instructions, included with each shipment, must be strictly followed.

END OF SECTION 05 51 36

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 13 – Architectural Design Selections

1.2 SUMMARY

A. All rough carpentry items including, but not limited to:
   1. Wood blocking for support of items supported on or requiring wood blocking for support.
   2. Wood cants, nailers, curbs, and other items associated with roofing work.
   3. Miscellaneous framing items and plywood sheathing.

1.3 RELATED WORK

A. All Sections of Work supported on or recessed into wood framing or requiring wood blocking for support, such as wall trim, wall cabinets, handrails, lockers, toilet compartments, toilet and bath accessories, markerboards, tackboards, projection screens, fire extinguisher cabinets, etc., as applicable to the Project.

1.4 SUBMITTALS

A. Product Data: Manufacturer’s data on wood treatment materials.

1.5 STANDARDS AND GRADING

A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization approved by the Architect, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks when approved by Architect. Trademark of manufacturer shall also appear on each piece.

B. Each piece of plywood used shall carry the American Plywood Association trademark.

C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.

D. Reference Standards: Conform with all requirements.
   1. U.S. Dept. of Commerce Product Standards (PS)
   2. American Plywood Association (APA)
      a. Standards and Construction Guide.

   3. American Wood Preservers Association (AWPA)

a. Standards, as they apply.

4. Architectural Woodwork Institute (AWI)
   a. "Quality Standards."

5. National Woodwork Manufacturers' Association (NWMA)
   a. Standards.

6. Western Wood Products Association (WWPA)
   a. Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Wood Blocking**:
   1. Treated No. 2, S4S Southern Yellow Pine, #1 kiln dried.
      a. Comply with NWMA Standards
      b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.

   2. No. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRTW lumber is not required by building code.
   3. Fire Retardant No, 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.

B. Plywood:
   1. Fire Retardant Treated Plywood: Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.

C. Rough Hardware:
   1. Nails, Spikes, Screws and Staples: Galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
   2. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
   3. Fasteners: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry and concrete. Bolts or power activated type for anchorage to steel.

D. Wood Treatment:
   1. Preservative Treatment (Concealed Conditions):
      a. Borate: Pressure impregnate preservative to net retention of 0.28 lbs./cu.ft., in plant licensed by manufacturer in accordance with the following standards:
         1) Preservative Treatment Standard: AWPA P5\
         2) Structural Lumber Treatment Standard: AWPA C31
         3) Plywood Treatment Standard: AWPA C9

b. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.
c. Provide Quality Mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
d. Concealed conditions mean conditions that are interior, above ground that are not exposed to direct standing water, in contact with natural grade, or exposed to weather.
e. ACQ and CCA preservatives not permitted.
f. Acceptable Manufacturers: Osmose “Advance Guard”; Universal Forest Products “ Prowood Borate”; or Architect approved equal.

2. Fire Retardant Treatment: (FTRW)
a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPA Standard C20.
b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPA Standards C27.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plywood:
1. Install FTRW plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.

END OF SECTION 06 10 00

THIS PAGE WAS INTENTIONALLY LEFT BLANK

SECTION 06 16 00 - SHEATHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements including but not limited to:
   1. Wall sheathing.
   2. Underlayment.
   3. Sheathing joint and penetration treatment.
   4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details:
   1. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   3. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
      a. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
   4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 QUALITY ASSURANCE

A. Fire Test Response Characteristics:
   1. For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction:
      a. Fire resistance ratings: Indicated by design designations from UL Fire Resistance Directory or GA-600 Fire Resistance Design Manual.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 MATERIALS

A. Plywood: DOC PS 1.

B. Oriented Strand Board: DOC PS 2.

C. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE TREATED PLYWOOD

A. Preservative Treatment by Pressure Process - AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground:
   1. Preservative chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE RETARDANT TREATED PLYWOOD

A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire Retardant Treated Plywood by Pressure Process:
   1. Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test:
      a. Use treatment that does not promote corrosion of metal fasteners.
      b. Exterior type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
      c. Design value adjustment factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.

C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.

E. Application:
   1. Treat plywood indicated on Drawings and the following:
      a. Roof and wall sheathing within 48 inches (1,220 mm) of fire walls.
      b. Subflooring and underlayment for raised platforms.

2.4 WALL SHEATHING

A. Glass Mat Gypsum Wall Sheathing - ASTM C1177/C1177M:
   1. Product is subject to compliance with requirements; provide products by one of the following:
      a. CertainTeed Corporation: GlasRoc (basis of design).
      b. Georgia Pacific: Dens-Glass.
      c. National Gypsum Company: Gold Bond eXP.
      d. United States Gypsum Co.: Securock.

2. Type and Thickness: Regular, 5/8 inch (15.9 mm) thick.
3. Size: 4 by 8 inches (1,220 mm by 2,440 mm) or 8 by 96 inches (1219 by 2438 mm) for vertical installation, unless otherwise noted.

B. Alternative: Air- and Water-Resistive Sheathing Board: ASTM C1177/C1177M, glass-mat-faced gypsum sheathing board.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensElement Barrier System or comparable product.
2. Board Thickness: 5/8 inch (15.9 mm) thick.
3. Board Type: Type X.
4. Board Size: 48 by 96 inches (1219 by 2438 mm) for vertical and horizontal installations.
5. Air- and Water-Resistive Flashing Thickness: Minimum 16 mil (0.41 mm) wet film thickness.
6. Physical and Performance Properties:
a. Air Permeance; ASTM E2178: Maximum 0.004 cfm/sq. ft. (0.02 L/s x sq. m) of surface area at 1.57 lbf/sq. ft. (75 Pa) pressure difference. b. Water Vapor Permeance: 25 perms (1436 ng/Pa x s x sq. m) or more when tested in accordance with ASTM E96/E96M, Procedure B. c. Combustion Characteristics; ASTM E84: Class A. d. Board Product Antifungal Properties; ASTM D3273: 10; zero defacement. e. VOC Content - Fluid-Applied Flashing: 50 g/L or less. f. UV and Weathering Resistance: Maximum 12-month exposure.

2.5 NOT USED

2.6 FASTENERS

A. Provide fasteners of size and type indicated that they comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing:
1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B117:
a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.

2.7 FLASHINGS

A. Fluid-Applied Air Barrier Flashing: Site-applied for application to joints, fasteners, penetrations, openings, and material transitions.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensDefy Liquid Flashing.
2. Color: tbd.

B. Flashing and Transition Strip: self-adhered membrane, 25 mils (0.64 mm) thick.
1. 1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; DensDefy Transition Membrane.

2.8 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

A. Sealant for Glass Mat Gypsum Sheathing:
1. Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners:

a. Sheathing tape: Self-adhering glass fiber tape, minimum two inches (50 mm) wide, ten by ten or ten by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with a history of successful in-service use.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

B. Joint Backing: See Section 07 92 00 "Joint Sealants" for backing materials.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Provide compatible air barrier accessory materials furnished or in accordance with air barrier manufacturer's written instructions as required by Project conditions to produce a complete air barrier assembly identical to tested assemblies meeting performance requirements.

B. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three (3) support members.

C. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

D. Securely attach to substrate by fastening as indicated.

E. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

F. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

G. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

H. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8-inch (9.5 mm) gap where non-load bearing construction abuts structural elements. Install boards with a 1/4-inch (6.4 mm) gap where they abut masonry or similar materials that retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation:

1. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud:
   a. Space fasteners approximately eight inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

END OF SECTION

This page intentionally left blank

SECTION 06 20 00 - FINISH CARPENTRY AND MILLWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Providing all finish carpentry items including, but not limited to:
   1. Finish Carpentry.
   2. Millwork and Cabinetry.
   3. Plastic Laminate.
   4. Casework Hardware.
   5. Miscellaneous Millwork.

B. Installation of:
   1. Door hardware.
   2. Plastic laminate faced wood doors.

1.3 REFERENCES

A. American National Standards Institute:
   1. ANSI A156.9 - Cabinet Hardware
   2. ANSI A161.1 - Woodwork Testing Standards
   3. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

C. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

1.4 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, perform work in accordance with AWI “Quality Standards Illustrated”, Custom Grade, except where specification exceeds those standards, the more stringent shall govern.

B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency, covering the following areas of product performance, with these minimum results:
   1. Base cabinet construction/racking test: 800 lbs.
   2. Cabinet front joint loading test: 425 lbs.
   3. Wall cabinet static load test: 2,000 lbs.
   4. Drawer front joint loading test: 600 lbs.
   5. Drawer construction/static load test: 750 lbs.
   6. Cabinet adjustable shelf support device/static load test: 300 lbs.

C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.5 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer’s preprinted product information for all hardware proposed on the project.
   3. Manufacturer’s preprinted maintenance instructions for the casework hardware.

B. Shop Drawings:
   1. Indicate size, material and finish.
   2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.

C. Certification: Provide manufacturer’s certification that casework has been fabricated and installed according to AWI “Custom” Grade guidelines or better.

D. Samples:
   1. Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.
   2. Plastic laminates, 8 inches by 10 inches (200 mm by 250 mm), for each type, color, pattern.

E. Closeout:
   1. Record Drawings: indicate revisions to original drawings and shop drawings
   2. Manufacturer contact names, addresses and phone numbers.
   3. Finish Material Schedule: names and color numbers of laminates and stains.
   4. Keys: Provide additional master key for each room and additional locksets totaling one percent of total project for attic stock.

1.6 QUALITY ASSURANCE

A. Manufacturer: Minimum of five (5) years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.

B. Delivery conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect’s discretion, a representative of the Architect may be present at the time of delivery. Casework not conforming to the specified requirements, as reasonably determined by the Architect’s representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockups of typical architectural cabinets shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRE-INSTALLATION CONFERENCE

A. Section 01 31 00 – Project Management and Coordination.

1.8 PRODUCT HANDLING

A. Deliver completed laminate clad casework, countertops and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

1.9 JOB CONDITIONS

A. Environmental Requirements: do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
   1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
   2. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.

B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

1.10 COORDINATION

A. Coordinate the Work of this Section with plumbing work specified in Division 15. Coordinate sink opening construction with sinks specified in Division 15.

B. Coordinate location of blocking in walls for installation and support of wall cabinets.

1.11 WARRANTY

A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to the following:
   1. Rough or difficult operation, or loose or missing parts.
   2. Delamination of surfaces.
   3. Noticeable deterioration of finish.
   4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 - PRODUCTS

2.1 MILLWORK MANUFACTURERS

A. Woodwork Institute listed Accredited Millwork Companies, current roster and shall not preclude Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project. Other manufacturers must have experience manufacturing products meeting or exceeding the specifications and must comply with the criteria performance set by the Woodwork Institute or as indicated in Part 1 of this Section and with Division 01 requirements regarding substitutions.
   1. Casework:
      a. Ameritek Design Inc.; (281) 442-7767.
      b. Calmar Manufacturing Co., Inc.;(563)562-3261.
      c. Case Systems, Inc.; (989) 496-9510

d. Global Casework Manufacturing, Inc.; (281) 494-6181.
e. Imperial Mill & Fixture, Inc.; (361) 883-4630.
f. Jericho Woodworks; (281) 969-7947.
g. Jim R. Reynolds & Associates, Inc.; (281) 350-1133.
h. LSI Corporation of America, Inc.; (763) 559-4664.
i. MGC Millwork, LP; TX (713) 772-0894.
j. South Texas Woodmill, Inc., Brownsville, TX; (956) 831-3304.
k. Stevens Industries, Inc.; (217) 540-3100.
l. Terrill Manufacturing Co.; (915) 655-7133.
m. TMI Systems Design Corp.; (701) 225-6716.
n. Victoria Cabinetworks; (361) 578-0263.
o. Alpha Omega Casework LLC; (512) 365-1776.

2.2 MILLWORK MATERIALS

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
1. Exterior Color Selection Available:
a. Architect to select from minimum of 250 selections available, including wood grain patterns and solid colors.
b. Provide 5 different colors available per project.
c. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.

2. Laminate grades:
a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
c. Cabinet Liner: CL20 (0.020 inch nominal), white.
d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.

3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
4. Pressure Fused Laminate:
a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
b. Color:
1) Closed interiors, underside of wall cabinets: White.
2) Exposed and Semi-exposed open cabinets: Match exterior.

c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.

B. Core Material:
1. Particleboard: ANSI 208.1, minimum 45 pcf density, Grade M-3.
2. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
3. Water resistant treated plywood: shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
4. Cabinet components shall be of the following minimum core thicknesses:

a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch particleboard
b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard
c. Work surfaces and countertops: minimum 1 inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14 inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
e. Cabinet Toe-Base: 3/4 inch plywood. No particleboard within four (4) inches of floor.

C. Countertops and Backsplashes:
1. Refer to Section 12 36 61 Solid Surface Countertops.

D. Toe Spaces: Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.

E. End Panels and Filler Strips: Match adjacent case-piece.

F. Edging:
1. Provide the following in accordance with “Edging Locations”:
a. Flat Edge PVC: 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
b. 3 mm PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.

2. Edging Locations:
a. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
c. Door/Drawer-Front edging: 3mm PVC, color matched to standard laminates.

2.3 CABINET HARDWARE

A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner.
1. Acceptable Manufacturers:
a. Accuride
b. National
c. Knape & Vogt
d. Ives
e. Stanley
f. As specified herein, provide specified product, or Architect approved equal.

B. Hinges:
1. Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.

2. One pair per door to 48 inch height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing.
3. Finish: US26D.

C. Pulls:
1. Wire design, 4 inches, Chrome, US26D finish.

D. Sliding Door Hardware:
1. Frameless 1/4 inch glass sliding doors: double track rolling door assembly.
2. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.

E. Drawer Slides:
1. Standard Drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
2. File Drawers: Full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
4. Paper Storage Drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.

F. Catches: Provide opening resistance in compliance with the Americans with Disabilities Act.
1. Provide top-mounted magnetic catch for base and wall cabinet door.
2. Provide two at each tall cabinet door. Catch housing shall be molded in White.

G. Adjustable Shelf Supports:
1. Dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
3. Load rating shall be minimum 300 pounds each support without failure.

H. Wardrobe Rod: 1-1/6 inch diameter plated steel rod, with captive sockets.

I. Coat Hooks: Single and double prong, wall mount - Satin Aluminum.

J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

2.4 SPECIALTY ITEMS

A. Grommets:
1. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
2. Colors: As selected by Architect from manufacturer's available colors.
3. Number/Location: Where electrical, telephone, and computer data wiring need to

pass through tops whether shown or not.

4. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc., Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.

2.5 SOLID STOCK

A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between 8 percent and 13 percent at time of installation.

B. Natural Finish Hardwood:
   1. Occasional knot permitted provided it is tight and smooth.
   2. Grain Pattern: Rift-cut
   3. Species: AWI "Premium" Grade, White Oak

C. Paint Grade Hardwood: Any species, including Parana Pine, except do not use Oak, Elm or similar species which have coarse grain.

2.6 MISCELLANEOUS

A. Utility Shelving: AWI "Economy" grade.

B. Clothes Rod: 1-1/2 inch diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.

C. Telephone/MDF/IDF Board: Provide minimum 4 foot by 8 foot by ¾ inch thick plywood for telephone/data punch down blocks and video equipment in accordance with Section 06 10 00, Rough Carpentry. Paint in accordance with Section 09 91 00, Painting.

2.9 MILLWORK FABRICATION

A. Fabricate casework, countertops and related products to dimensions, profiles and details shown on drawings. Fabricate casework square, plumb, and true.

B. Detailed Requirements For Cabinet Construction:
   1. Toe-Base:
      a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor
      b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material.
      c. No cabinet sides-to-floor will be allowed.

   2. Cabinet Top and Bottom:
      a. Solid sub-top shall be furnished for all base and tall cabinets.
      b. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider.
      c. Assembly devices shall be concealed on bottom side of wall cabinets.

   3. Cabinet Sides:
      a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
      b. Drill holes for adjustable shelves 1-1/4 inches on center.

   4. Cabinet Backs:

a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings.

5. Exposed end corner and face frame attachment:
   a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
   a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
   b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
   c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.

C. Drawers:
1. Drawer fronts: apply to separate drawer body component sub-front.
2. Drawer sides: doweled to receive front and back, glued under pressure, machine squared.
3. Drawer bottom: set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
4. Paper storage drawers: fitted with full width hood at back.
5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.

D. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.

E. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.

F. ADA Accessible, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as “ADA”, or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.
5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than

11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

G. Typical Desk or Counter Height at Kneespace Locations: 30” above finished floor.

PART 3 - EXECUTION

3.1 MILLWORK INSTALLATION

A. Positioning: Place approximately level, plumb and at right angles to adjacent work.

B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.

C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.

D. Fasten tops to frames with concealed clips, screws and glue.

E. Install simulated wood trim in locations shown on drawings and in accordance with manufacturer’s instructions.

3.2 FINISH HARDWARE INSTALLATION

A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.

B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at his expense.

C. Provide clean, properly sized and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.

D. Fit all surface-applied hardware accurately.

E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.

F. Remove all door hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.

G. Millwork contractor shall be responsible for hardware on millwork.

3.4 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

A. Protect all doors during handling.

B. Refer to Section 08 71 00, Door Hardware for hardware requirements.

C. Install doors in accordance with manufacturer’s instructions.

D. Install and adjust doors for smooth, quite operation.

END OF SECTION 06 20 00

SECTION 07 16 00 - BELOW GRADE WATERPROOFING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparation of concrete surfaces to receive waterproofing membrane.

B. Sealing of cracks and joints.

C. Fluid applied waterproofing system, with prefabricated drainage composite or protection board at walls that fall below grade (auditorium, basement, elevator pit, etc.).

D. Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete

B. Section 07 92 00 - Building Sealants

C. Division 23 - Mechanical: Mechanical penetrations, such as floor drains and piping, through waterproofing membrane.

D. Division 26 - Electrical: Electrical penetrations, such as conduit, through waterproofing membrane.

1.3 SUBMITTALS

A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturer's installation instructions.

B. Certifications:
1. Manufacturers certification that applicator is approved by Manufacturer.
2. Manufacturer’s affidavit that materials used in Project contain no asbestos.

C. Warranty: Submit a sample warranty identifying the terms and conditions stated in warranty.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system Manufacturer.

B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).

1.5 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials job site in original, factory-sealed, unopened containers bearing Manufacturer's name and label intact and legible with following information.
   1. Name of material.
   2. Manufacturer's stock number and date of manufacture.
   3. Material safety data sheet (MSDS).

B. Store and handle in strict compliance with Manufacturer’s instructions, recommendations and material safety data sheet (MSDS).

C. Protect from damage from sunlight, weather, excessive temperatures and construction operations.

D. Remove damaged material from the site and dispose of in accordance with applicable regulations.

E. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides.

F. Store drainage composite and protection board flat and off the ground. Provide cover on top and all sides.

G. Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.

H. Sequence deliveries of materials to avoid delays but minimize on-site storage.

1.7 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the Manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

C. Coordinate waterproofing work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.

D. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.

E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.

F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.

G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.

1.8 WARRANTY

A. Warrant the work specified herein for ten (10) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

PART 2 - PRODUCTS

2.1 FLUID APPLIED WATERPROOFING SYSTEM - POST APPLIED

A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Membrane 500)
2. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (Barricoat)
3. GCP Applied Technologies, Cambridge, MA (Procor)
4. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol LM)

B. Fluid Applied Waterproofing Membrane: Water-based rubber and / or bitumen liquid / fluid applied waterproofing membrane modified with high performance rubberized polymers and special additives for use in vertical seamless applications.

Waterproofing Membrane Physical Properties, minimum:

Property	Test Method	Typical Value
Cured / Dry Film Thickness	ASTM D3767	60 mils
Solids Content	---	62%
Low Temp Flexibility	ASTM C836	Pass
Elongation	ASTM D412	500%
Pliability	ASTM D1970	Unaffected
Resistance to Standing Water	ASTM D2939	Pass

C. Accessory Products:
1. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cuspated under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.

D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

2.2 SHEET APPLIED WATERPROOFING SYSTEM - POST APPLIED

A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Carlisle Coatings and Waterproofing Incorporated, Wylie, TX (MiraDRI 860/861)
2. W. R. Meadows, Inc., Hampshire, IL (Mel-Rol)

B. Sheet Applied Waterproofing Membrane: Self-adhering sheet membrane consisting of rubberized asphalt laminated to a polyethylene film.

Waterproofing Membrane Physical Properties, minimum:

Property	Test Method	Typical Value
Thickness	ASTM D3767	60 mils
Low Temp Flexibility	ASTM D1970	Pass
Elongation	ASTM D412	350%
Puncture Resistance	ASTM E154	50 lbf
Hydrostatic Head	ASTM D5385	230 ft

C. Accessory Products:
1. Primer: Manufacturer's recommended spray or roller applied water-based adhesive.
2. Detail Sealant: Manufacturer's recommended sealant material for use at penetrations, cut edges, top edge terminations, transitions, etc. and adhesion for the protection course.
3. Detail Strip: Manufacturer's recommended waterproofing membrane material.
4. Protection Coarse: Prefabricated drainage composite material designed to promote positive drainage while serving as a protection course. Provide product consisting of an impermeable polymeric sheet cuspated under heat and pressure to form a high flow dimpled drainage core with a bonded layer of nonwoven filter fabric.
5. Termination Bar: High strength, pre-formed, multi-purpose plastic strip with holes 6" o.c.

D. Locations: Vertical and horizontal below-grade structural concrete foundation walls opposite conditioned and habitable areas that fall below grade 0'-0" and where shown on drawings.

2.3 SHEET APPLIED WATERPROOFING SYSTEM - PRE-APPLIED

A. Specifications are based on named Manufacturer's products and systems listed below. Other Manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. AVM Industries, Inc. Canoga Park, CA (AVM Aussie Skin 550G)
2. GCP Applied Technologies, Cambridge, MA (Preprufe 200)

B. Sheet Waterproofing Membrane: Composite sheet comprising a heavy duty, puncture resistant, HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure.

C. Accessory Products:
1. Pressure Sensitive Tape: Two-sided, reinforced, pressure sensitive tape constructed with a highly aggressive adhesive. Material to form a continuous and integral seal to the structure (GCP Prefrufe CJ Tape).
2. Detail Sealant: Manufacturer's approved sealant intended for use sealing around penetrations.

D. Locations: Vertical below-grade structural concrete foundation walls opposite conditioned and habitable areas as well as horizontal surfaces below the slab that fall below grade 0'-0" and where shown on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before waterproofing work is started the all surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

3.2 SURFACE PREPARATION

A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry and free from all surface contaminates or cleaning residue that may harmfully affect the adhesion of the membrane.

B. Repair all cracks in accordance with Manufacturer’s instructions.

3.3 APPLICATION

A. Priming: Shall be in accordance with membrane Manufacturer's instructions.

B. Apply waterproofing in accordance with membrane Manufacturer's instructions.

C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the Manufacturer.

D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install Manufacturer’s recommended drainage composite or protection board / protection course on remainder.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Polyisocyanurate foam plastic board.
2. Thermal insulation.
3. Glass fiber blanket.
4. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry.

B. Section 07 81 00 - Applied Fireproofing.

C. Section 07 84 00 – Firestopping.

D. Section 09 21 16 - Gypsum Board Assemblies.

E. Section 09 51 00 - Acoustical Ceiling Panels.

F. Division 23 – Mechanical: Duct Insulation.

1.5 SUBMITTALS

A. Product Data: Technical data and installation instructions for each type of insulation product specified.

B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect’s approval.

C. Certifications:
1. Manufacturer’s certification of compatibility of rigid insulation with dampproofing mastic.
2. Manufacturers affidavit that materials used in Project contain no asbestos.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization.

a. Surface Burning Characteristic: ASTM E 84:
   1) Flame Spread Index: Maximum 25.
   2) Smoke Developed Index: Maximum 450.

b. Fire Resistance Ratings: ASTM E 119.
c. Combustion Characteristics: ASTM E 136.

2. National Fire Prevention Association (NFPA) 255 Test of Surface Burning Characteristics of Building Materials.
3. Underwriter's Laboratories (UL) 723 Tests for Surface Burning Characteristics of Building Materials.

B. Cellulose Insulation Manufacturer: Manufacturer having minimum 5 years documented experience and ISO 9002 Certified.
   1. Manufacturer shall provide independent laboratory follow up inspection services of Underwriters Laboratory and Factory Mutual. Label each bag accordingly.

C. Cellulose Insulation Applicator: Applicator having minimum 5 years documented experience and licensed by manufacturer.

D. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.

E. Environmental Requirements: Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
   1. Wherever possible, provide boards from manufacturers who recycle insulation materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam plastic board insulation:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.8 PROJECT CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Sequence Work to ensure fireproofing and firestop materials are in place before beginning Work.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS/PRODUCTS

A. Specifications are based on any of the manufacturers listed below, with their product in parenthesis for the particular insulation application. Other manufacturers not listed must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 regarding substitutions to be considered.

2.2 EXTRUDED POLYSTRENE FOAM BOARD

A. Extruded, Polystyrene Foam Board: ASTM C578, Type IV.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Chemical Company (The).
      b. Owens Corning.
      c. Comparable product.

2.3 THERMAL INSULATION

A. Themal Insulation, Unfaced: ASTM C 665, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Guardian Building Products, Inc.
      c. Johns Manville; a Berkshire Hathaway company.
      d. Knauf Insulation.
      e. Owens Corning.

   2. Thickness/R- Values (minimum):
      a. 3-1/2 inches/ R-11 where shown on the Drawings.
      b. 6 inches/ R-19 where shown on the Drawings.

2.4 ACOUSTICAL INSULATION (SOUND ATTENUATION)

A. Acoustical Insulation (Sound Attenuation), Unfaced: ASTM C 612, Type I. with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Guardian Building Products, Inc.
      c. Johns Manville; a Berkshire Hathaway company.
      d. Knauf Insulation.
      e. Owens Corning.

   2. Thickness/R- Values (minimum):
      a. 3-1/2 inches/ R-11 where shown on the Drawings.
      b. 6 inches/ R-19 above lay-in ceiling specified and where shown on Drawings.

2.5 GLASS FIBER BLANKET

A. Glass Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Guardian Building Products, Inc.
      c. Johns Manville; a Berkshire Hathaway company.
      d. Knauf Insulation.
      e. Owens Corning.

2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   2. Spindle: Coppercoated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
   2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
      a. Crawl spaces.
      b. Ceiling plenums.
      c. Attic spaces.

D. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches (50 mm) between face of insulation and substrate to which anchor is attached.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.7 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Glass Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

C. Asphalt Coating for Cellular Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

B. Foam in Place Insulation: Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
1. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Board Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

C. Batt Insulation (Thermal and Sound): Walls: Insulation shall be friction fit between studs and provide full coverage where indicated on Drawings. Insulation shall be tight within spaces n partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.

D. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 - "Unit Masonry."
2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.

E. Framed Construction: Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 21 30 - PRE-ENGINEERED BUILDING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-Engineered Building Insulation for New Construction.

1.2 RELATED SECTIONS

A. Section 13 34 19 - Metal Building Systems.

1.3 REFERENCES

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E 96 - Standard Test Method for Water Vapor Transmission of Materials in Sheet Form (Procedure B).

C. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

D. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

E. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

F. ASTM C 1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

1.4 DESIGN REQUIREMENTS

A. Thermal Resistance of Installed System: R-Value of 30.

B. Insulating system shall have a continuous vapor barrier inside of building purlins, girts, and insulation to provide complete isolation from inside conditioned air.

1.5 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions.

C. Shop Drawings: Indicate locations of connections and attachments, general details, anchorages and method of anchorage and installation.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square or long, representing actual products required for this project.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing product systems specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing work of this section.

C. Insulation system components to include a ten-year limited material warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products indoors and protect from moisture, construction traffic, and damage.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 **MANUFACTURERS**

A. Acceptable Manufacturer: Thermal Design, Inc., Simple Saver System. P.O. Box 468, 601 N. Main Street, Madison, NE 68748. ASD. Tel: (800) 255-0776; or Architect approved equal.
B. Requests for substitutions will be considered in accordance with provisions of Division 01.

2.2 **MATERIALS**

A. Simple Saver System consists of Wall Insulation, Vapor Barrier Liner Fabric, Thermal Breaks, Straps, and other devices and components in a proprietary insulation system as follows:
   1. Batt Insulation: ASTM C 991 Type 1; preformed formaldehyde-free glass fiber batt conforming to the following:
      a. Thermal Resistance: R of 19.
      b. Batt Size: Equal to purlin/girt spacing by manufacturer's standard lengths.
      c. Unfaced.
   2. Vapor Barrier Liner Fabric: Syseal® type woven, reinforced, high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene coatings, as follows:
      a. Product complies with ASTM C 1136, Types I through Type VI.

b. Perm rating: 0.02 for fabric and for seams in accordance with ASTM E 96.
c. Flame/Smoke Properties:
   1) 25/50 in accordance with ASTM E 84.
   2) Self-extinguishes with field test using matches or butane lighter.
d. Ultra violet radiation inhibitor to minimum UVMAX® rating of 8.Size and seaming: Manufactured in large custom pieces by extrusion welding from roll goods, and fabricated to substantially fit defined building area with minimum practicable job site sealing.
e. Provide with factory double, extrusion welded seams. Stapled seams or heat-melted seams are not acceptable due to degradation of fabric.
f. Factory-folded to allow for rapid installation.
g. Color:
   1) Super white.

3. Vapor Barrier Lap Sealant: Solvent-based, Simple Saver polyethylene fabric adhesive.
4. Vapor Barrier Tape: Double-sided sealant tape 3/4 inch (19 mm) wide by 1/32 inch (.79 mm) thick.
5. Vapor Barrier Patch Tape: Single-sided, adhesive backed sealant tape 3 inches (76 mm) wide made from same material as Syseal® type liner fabric.
6. Thermal Breaks:
   a. 1/8 inch (3 mm) thick by 3 inch (76 mm) wide white, closed-cell polyethylene foam with pre-applied adhesive film and peel-off backing.
   b. Polystyrene Snap-R snap-on thermal blocks.
7. Straps:
   a. 100 KSI minimum yield tempered, high-tensile-strength steel.
   b. Size: Not less than 0.020 inch (0.50 mm) thick by 1 inch (25 mm) by continuous length.
   c. Galvanized, primed, and painted to match specified finish color on the exposed side.
   d. Color:
      1) White.
   e. Primed and painted to match specified finish color on the exposed side.
   f. Color:
      1) Black.
   g. High-tensile-strength stainless steel.
   h. Woven polyester plastic. Color as selected.
8. Fasteners:
   a. For light gage steel: #12 by 3/4 (19 mm) inch plated Tek 2 type screws with sealing washer, painted to match specified color.
   b. For heavy gage steel: #12 by 1-1/2 inch (38 mm) plated Tek 4 type screws with sealing washer, painted to match specified color.
   c. For wood, concrete, other materials: As recommended by manufacturer.
9. Wall Insulation Hangers: Fast-R preformed rigid hangers, 32 inch (813 mm) long galvanized steel strips with barbed arrows every 8 inches (203 mm) along its length.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building structure including all bracing and any concealed buildingsystems

are completed and approved prior to installing liner system and insulation in the structure.

B. Correct any unsatisfactory conditions before proceeding.

C. If conditions are the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION - GENERAL

A. Install pre-engineered building insulation system in accordance with manufacturer's installation instructions and the approved shop drawings.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install in exterior spaces without gaps or voids. Do not compress insulation.

D. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

E. Fit insulation tight in spaces and tight to exterior side of the sealed liner fabric and around mechanical and electrical services within plane of insulation.

3.3 WALL INSULATION INSTALLATION

A. Insulation:
1. Install thermal break to exterior surface of girts as wall sheathing is applied.
2. (Optional) Install self-sticking foam thermal break to interior surface of girts prior to installation of insulation.
3. Position and secure Fast-R hangers to girts on the inside face of the wall sheathing.
4. Cut insulation to required lengths to fit vertically between girts.
5. Fluff the insulation to the full-specified thickness.
6. Neatly position in place and secure to Fast-R hangers.
7. Ensure that cavities are filled completely with insulation.

B. Vapor Barrier Fabric:
1. Install vapor barrier fabric in large one-piece custom fabricated pieces to substantially fit defined building areas with minimum practicable job site sealing.
2. Apply the vapor barrier fabric by clamping it in position over eave strap and installing fasteners through the eave strap into each roof strap, permanently clamping the wall fabric between them.
3. Once in position, draw the vapor barrier fabric down over the column flanges to the base angle and install vertical straps along each column and 5 feet 0 inches on center, maximum, fastening to each girt to retain system permanently in place.
4. All seams must be completely sealed and stapled seams not acceptable.

C. Seal wall fabric to the roof fabric, to the base angle and up the columns to provide a continuous vapor barrier.

3.4 CLEANING

A. Clean dirt or exposed sealant from the exposed vapor barrier fabric.

B. Remove scraps and debris from the site.

3.5 PROTECTION

A. Protect system products until completion of installation.

B. Repair or replace damaged products before completion of insulation system installation.

END OF SECTION

SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Fluid-applied air barrier membrane in exterior wall assemblies.

B. Materials to bridge and seal the following air leakage pathways and gaps:
1. Connections of the walls to the roof air barrier.
2. Connections of the walls to the foundation air barrier.
3. Seismic and expansion joints.
4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
5. Barrier precast concrete and other envelope systems.
6. Door frames.
7. Piping, conduit, duct and similar penetrations.
8. Masonry ties, screws, bolts and similar penetrations.
9. All other air leakage pathways in the building envelope.

C. Related Work in other Sections includes but is not limited to the following:
1. Section 01 45 00 – Quality Control
2. Section 01 50 00 – Temporary Facilities and Controls
3. Section 03 30 00 – Cast-In-Place Concrete
4. Section 04 20 00 – Unit Masonry
5. Section 07 41 13 – Prefinished Metal Roofing
6. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
7. Section 07 65 00 – Flexible Flashing
8. Section 07 90 00 – Joint Sealants
9. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

1.3 PERFORMANCE REQUIREMENTS

A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).

B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).

C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft2 @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.
2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.

D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:

1. Foundation and walls, including penetrations, ties and anchors.
2. Walls, windows, curtain walls, storefronts, louvers or doors.
3. Different wall assemblies, and fixed openings within those assemblies.
4. Wall and roof connections.
5. Floors over unconditioned space.
6. Walls, floor and roof across construction, control and expansion joints.
7. Walls, floors and roof to utility, pipe and duct penetrations.
8. Seismic and expansion joints.
9. All other potential air leakage pathways in the building envelope.

1.4 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

1.5 SUBMITTALS

A. Submittals: Submit in accordance with Division 1 requirements.

B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America’s (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).

C. Product Data: Submit material Manufacturer’s Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.

1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer’s material.
2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.

D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.

E. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

F. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).

1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.

B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.

C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).

D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.

E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer’s field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.

F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. The mock-ups shall remain visible and intact for the duration of the fluid applied air barrier system work scopes.

G. Mock-Up Tests for Air and Water Infiltration: The General Contractor shall provide testing of the window and door opening(s) in the mock-up for air and water infiltration. The testing shall be in accordance with AAMA 501.2 (hand wand field testing), If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.

H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.

C. Handle materials in accordance with Manufacturer’s recommendations.

1.8 PROJECT CONDITIONS

A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.

B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.

C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.

D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.

E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

1.9 WARRANTY

A. Material Warranty: Provide Manufacturer’s standard product warranty, for a minimum 20 years from date of Substantial Completion.

B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:

1. Carlisle Coatings and Waterproofing: Fire-Resist Barritech VP at 60 mils thick (wet). www.carlisle-ccw.com:

    a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft^2 @ 1.57 psf), at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (817 ng/(Pa·s·m^2) / 14.295 US perms) at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Detail Flashing: Fire-Resist 705 FR.
2) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
3) Water-Based Primer for Detail Flashing: CCW-702 WB.
4) Solvent-Based Primer for Detail Flashing: CCW-702 or CCW-702 LV.
5) Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP.
6) Reinforcing Fabric: DCH Reinforcing Fabric.
7) Glass Mat: LiquiFiber-W.
8) Termination Mastic: SURE-SEAL Lap Sealant.
9) Fill Compound: CCW-201 or CCW-703 V.
1)

2. Grace Construction Products: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry). www.na.graceconstruction.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0004 cfm/ft^2 @ 1.57 psf), at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (741.6 ng/(Pa·s·m^2) / 12.9 US perms) at 40 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Membrane for details and Terminations: Bituthene Liquid Membrane.
2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC or Bituthene Primer B2.
4) Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing below the flexible through wall flashing system.
5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
7) Penetrations and Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.

8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.

3. Henry Company: Air Bloc 17MR at 48 mils (wet) - *Medium build option*. www.henry.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft^2 @ 1.57 psf), at 48 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 28 US perms at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Liquid Applied Flashing: Air-Bloc LF.
2) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
3) Sheathing Joint Membrane: Blueskin VP160.
4) Spray Adhesive: Blueskin Adhesive and Blueskin LVC Adhesive.
5) Water-Based Primer for Transition Membrane: Aquatac Primer.
6) Counterflashing for Metal Panel Through-Wall Flashing: Blueskin TWF.
7) Sealant: HE 925 BES Sealant.
8) Reinforcing Tape: HE 183 Yellow Glass Fabric.
9) Insulation Adhesive: Air-Bloc 21.

4. Tremco, Inc.: ExoAir 230 at 40 mils (wet) www.tremcosealants.com

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.0003 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0003 cfm/ft^2 @ 1.57 psf), at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 1677 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1677 ng/(Pa·s·m^2) at 29 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Solvent Based Primer: ExoAir Primer
2) Termination Mastic: ExoAir Termiantion Mastic
3) Sealants: Tremflex 834, Dymonic 100, Spectrem 1
4) Transition Membrane for Details and Terminations: ExoAir 110, ExoAir 111, ExoAir TWF, Dymonic 100
5) Reinforcing / Joint Tape: Tremco 2011 mesh
6) Flashing at Transition Membrane: ExoAir 111, ExoAir TWF, Dymonic 100
7) Counterflashing for Through Wall Flashings: ExoAir TWF

8) Through Wall Flashings or Shelf Angle Flashings: ExoAir TWF below the flexible through wall flashing system.
9) Solvent Based Primer for Flashing, Transition Strip and Detail Membrane: ExoAir Primer
10) Substrate Joint Treatment: Tremflex 834, Dymonic 100 depending on substrate.

5. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry). www.wrmeadows.com:

a. AIR BARRIER MATERIAL PROPERTIES:

1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft2 @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m2) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m^2) [10.47 US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

1) Water-Based Primer: None required for Air Shield LMP.
2) Solvent-Based Primer: None required for Air Shield LMP.
3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
4) Termination Mastic: Pointing Mastic or BEM.
5) Transition Membrane for details and terminations: Air Shield.
6) Reinforcing / Joint Tape: Reinforcing Fabric HCR.
7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
8) Counter-flashing for Through-Wall Flashings: Air Shield Thru-Wall Flashing.
9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing below the flexible through wall flashing system.
10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
12) Substrate Joint Treatment: Air Shield Joint Filler.

2.2 AUXILIARY MATERIALS

A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.

B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.

1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
3. Ensure that the following conditions are met:
   a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
   b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
   c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.
   d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

1. Ensure that penetrating work by other trades is in place and complete.
2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.

B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:

1. Prime masonry, concrete substrates with conditioning primers.
2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
3. Prime wood, metal, and painted substrates with primer.
4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.

C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.

D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:

1. Mask and cover adjacent areas to protect from over-spray.
2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

3.3 INSTALLATION

A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions and the following (unless Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):

1. Install veneer anchors as per air barrier Manufacturer installation sequencing.
2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer’s instructions, ensuring chemical compatibility amongst adjoining materials.
7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer’s instructions.
8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
10. Lap transition material over top edge of through-wall flashing and head-flashing.
11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
12. Provide transition material to joint assemblies at expansion and seismic joints.
13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.
14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.

16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
19. Do not allow materials to come in contact with chemically incompatible materials.
20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.
21. Turn flashing membrane into window opening at sill, jambs and heads. Terminate just before interior sealant bead.

3.4 FIELD QUALITY CONTROL

A. Owner's Inspection and Testing: Cooperate with Owner's testing agency as applicable. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

B. Manufacturer's Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer's Field Representative on site. The Manufacturer's Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

3.5 PROTECTING AND CLEANING

A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.

1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

END OF SECTION

SECTION 07 41 13 - PREFINISHED METAL ROOFING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish all labor, materials, tools, equipment and services for all preformed roofing as indicated.

B. Coordinate with work of other trades.

C. It is the intent of this Section that the Work shall:
   1. conform to all applicable building code requirements and of authorities having jurisdiction;
   2. include, but not limited to:
      a. Preformed, prefinished metal roof panels;
      b. Roof insulation;
      c. Vapor barrier / underlayment;
      d. Substrate board, if shown or required by authorities having jurisdiction;
      e. Structural roof deck;
      f. Flashings;
      g. Gutters, downspouts and splash pans and splash blocks;
      h. Roof jacks;
      i. Roof curbs;
      j. All supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, weathertight, and complete installation.
   3. be performed by a single source contractor.

1.2 RELATED WORK

A. Division 5 Sections as required; generally: structural steel, steel joists, and miscellaneous metals.

B. Section 06 10 00 - Rough Carpentry

C. Section 07 62 00 – Roof Related Sheet Metal

D. Divisions 22, 23 and 26: All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items penetrating roofing system.

1.3 REFERENCES

A. American Institute of Steel Construction (AISC)
   1. Manual of Steel Construction

B. American Iron and Steel Institute (AISI)
   1. Cold Formed Steel Design Manual

C. ASTM International (ASTM)
   1. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

2. A792, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
3. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
4. E108, Standard Test Methods for Fire Tests of Roof Coverings
5. E1514, Standard Specification for Structural Standing Seam Steel Roof Panel Systems
6. E1592, Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
7. E1646, Standard Test Method for Rate of Water Penetration Through Exterior Metal Roof Panel Systems By Uniform Static Air Pressure Difference
8. E1680, Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
9. E2140 - Standard Test method for water penetration of metal roof panel systems by static water pressure head

D. Underwriters' Laboratories (UL)
1. Tests for Uplift Resistance of Roof Assemblies
2. Tests for Impact Resistance of Roofing Materials

E. Factory Mutual Research Corporation (FM) (FMRC)
1. Class 1-90 Windstorm Rating
2. Class 1-SH (Test 4471) Hail Damage Rating

F. International Conference of Building Officials (ICBO)
1. ICBO Evaluation Services, Inc. Report No. ER-5409

G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual

H. ASCE-7 Wind uplifts requirements for geographical area.

I. International Building Code

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
1. Manufacturer must have a minimum of three (3) years' experience manufacturing roof panels of the type specified for this Project. Panels specified in this Section shall be produced in a factory environment or by Manufacturer's certified and approved on-site roll forming equipment to assure the highest level of quality control. A letter certifying compliance should accompany the product material submittal.

B. Installer's Qualifications:
1. Installer of the system shall be an approved installer, certified and authorized by the Manufacturer as trained and qualified to install the Manufacturer's product. Provide a letter of certification from Manufacturer that installer has a minimum of three (3) year of metal roof panel installation experience preceding the date upon which work is to commence. **(Submit a copy with Proposal Form).**

C. Field Measurements: Prior to fabrication of panels, take field measurements of structure or substrates to receive panel system. Allow for trimming panel units, where final dimensions cannot be established prior to fabrication.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Performance Testing:
1. All panels must be FM Class 1-90 Windstorm Rating tested. Roofing system shall be installed in accordance with ASCE-7-16 wind uplift requirements for geographical location and a 150 MPH 3-second gust wind speed zone, Exposure B with an importance factor of 1.15 based on IBC requirements. Wind-resistance loads as indicated by structural engineer.
2. Panel system shall have an FM Hail Damage Rating of Class 1-SH (Test 4471).
3. Panel system shall have a Class “A” Fire Rating in accordance with ASTM E108.
4. Metal roof system must be installed to resist the roof design pressures calculated in accordance with IBC or authorities having jurisdiction. Determine panel bending and clip-to-clip strength by testing in accordance with ASTM E1592. Capacity for gauge, span or loading other than those tested may be determined by interpolating test results by engineer supplying calculations.
5. Metal roof system must meet the air infiltration requirements of ASTM E283 when tested with a 6.24 PSF pressure differential with resulting air infiltration of 0.0071 cfm/sq. ft.
6. Metal roof system must meet the water penetration requirements of ASTM E331 when tested with a 12.00 PSF pressure differential with no uncontrollable water leakage when five (5) gallons per hour of water is sprayed per square foot of roof area.
7. ICBO Evaluation Services, Inc. Report No. ER-5409 is in compliance with UBC authorities having jurisdiction.

1.6 SUBMITTALS

A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturer's installation instructions.

B. Shop Drawings: Include layouts of panels, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashing, closures and special details. Distinguish between factory and field assembly work.

C. Calculations:
1. All calculations shall be sealed by a professional engineer licensed in the State of Texas.
2. Engineering calculations defining cladding loads on all roof areas based on specified building codes, allowable clip loads and required number of fasteners to secure the panel clips to the designated substructure.
3. Uplift loads on clip fasteners with full recognition of prying forces and eccentric clip loading.
4. Calculate holding strength of fasteners in accordance with submitted test data provided by fastener Manufacturer based on length of embedment and properties of materials.

D. Samples:
1. Color charts or samples from Manufacturer’s full line of standard and custom Kynar 500® or Hylar 5000® finishes for Architect’s selection.
2. One (1) foot long sample of coated panel, including clips and fasteners.

E. Certifications:
1. Manufacturer's certification that fasteners, clips, backup plates, closures, roof panels and finishes meet specification requirements and wind uplift requirements.
2. Manufacturer's certification that Installer meets requirements to install roof system and is qualified to obtain required warranties and has been certified for 3-years prior to proposal due date
3. Letter of certification from Manufacturer that installer is in compliance and meets specified requirements.
4. Letter of certification from Manufacturer that panels have been produced in a factory environment or with certified / approved fixed-base roll forming and leveler equipment.
5. Certified test results by a recognized testing laboratory or Manufacturer's laboratory (witnessed by a professional engineer) in accordance with specified performance test methods for each panel system.
6. Manufacturer's certification that materials are in compliance with the specifications, including but not limited to finish and panel material.
7. Manufacturer's affidavit that materials used in Project contain no asbestos.

F. Testing Reports: Showing metal panels have been tested in accordance with specified performance testing requirements.

G. Warranty: Manufacturer's warranty as specified.

1.7 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver metal roof system to job site properly packaged to provide protection against transportation damage.

B. Handling: Exercise extreme care in unloading, storing and erecting metal roof system to prevent bending, warping, twisting and surface damage.

C. Storage:
1. Store all materials and accessories above ground on well skidded platforms.
2. Store under waterproof covering.
3. Provide proper ventilation of metal roof system to prevent condensation build-up between each panel or trim / flashing component.

1.9 WARRANTY

A. Warrant the work specified herein against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship. Warranty shall be a "Weather tightness" Warranty. Field Reports are required throughout Project and are to be supplied by a Manufacturer's Approved Technical Inspector. Manufacturer's personnel which are not Quality Control Technicians are not acceptable for inspection.
1. Roof Panels and Finish:
a. Durability of the roof panels due to rupture, structural failure or perforation shall be warranted for a period of 20 years by the Manufacturer.

b. The exterior color finish for painted roof panels shall be warranted by the Manufacturer for 20 years against chalking, blistering, peeling, cracking, flaking, checking and chipping.

2. Weathertightness:
   a. The entire roof system including all roof panels, flashings, curbs, interior gutters, etc. shall be warranted by the Manufacturer against leaks for a period of 20 years.
   b. The warranty shall be issued to the Owner by the Manufacturer at time of entire Project Substantial Completion.
   c. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation.
   d. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system by the Manufacturer, including materials and labor, shall be done at no cost to the Owner for duration of warranty period.
3. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the Manufacturer for the remaining three (3) years.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Manufacturers listed who produce products equivalent to those specified are approved for use on the Project. Other Manufacturers must have a minimum of ten (10) years' experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
   1. AEP-Span; Dallas, TX; (214) 827-1740
   2. Fabral; Grapevine, TX; (800) 477-9066
   3. MBCI; Houston, TX; (281) 445-8555
   4. Carlisle Syntec, Inc.; Carlisle, PA, 800-479-6832
   5. Peterson Aluminum (PAC CLAD); Tyler, TX, (800) 441-8661
   6. Berridge Manufacturing Co.; San Antonio, TX; (800) 669-0009
   7. McElroy Metal; Bossier City, LA, (800) 950-6531
   8. UNA-CLAD; Anoka, MN, (800) 426-7737

B. Specifications are based on "138T" architectural structural standing seam metal roof system manufactured by McElroy Metal.

C. Materials shall be manufactured, specified, or accepted in writing by Roofing Manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said Manufacturer.

D. Roof panels with lap type side joints or those requiring battens or other non-integral sealing means or exposed structural fasteners will not be acceptable.

E. Roof panels shall be roll formed in the Manufacturer's plant to control quality or by certified / calibrated / approved on-site roll-forming equipment only.

F. Substitute Manufacturers will be approved by written addendum to all bidders. Voluntary alternates will not be considered. Substitutions will not be permitted after the bid date of this project.

G. Roof panels proposed for substitution shall fully comply with specified requirements in performance.

H. Roof panels shall have a 20 year foamable mastic sealant plant-installed sealant for quality control. No solid butyl sealant or extruded rubber will be accepted.

2.2 MATERIALS

A. Metal Roof Panels:
1. (T-Panel) Panel Profile / Dimensions: 1 3/8" high vertical legs shall be spaced at 16 inches on-center striated panel in continuous length with mechanically seamed sidelaps.
2. Gauge: Minimum 24 gauge (UL 90 rated)
3. Sheet Material: Prefinished Galvalume Sheet Steel - ASTM 792-AZ-50.
4. Texture: Striations.
5. Finish: Full strength Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the Manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000 finish supplier. Color shall be selected by Architect from Manufacturer's full range of standard and custom non-metallic colors. (20 year warranty)
6. Touch-up Paint: Paint burns, scars, welds, and damaged and rusted surfaces with cold galvanizing paint in accordance with ASTM A780. Acceptable Products include ZRC Cold Galvanizing Compound manufactured by ZRC Chemical Products, Quincy, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawerence, MA; or paint complying with military specification MILP-21035A, Type I or II.
7. Strippable Film: Applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. Remove strippable film prior to installation.
8. Roof Panel Intermittent Clip: 16 gauge galvanized steel, one-piece or two-piece, designed to allow roof panel thermal movement and not contact roof panel cap, as supplied by Metal Roof Panel Manufacturer, meeting wind uplift requirements and design criteria of this section.
9. Roof Panel Intermittent Clip Bearing Plate: If required, in gauge, size and finish as supplied by and approved by Metal Roof Panel Manufacturer for use in Metal Roof Panel Manufacturer's full assembly warranted systems.
10. Roof Panel Multi-Span Clip: As provided by Metal Roof Panel Manufacturer for full assembly warranted systems.
11. Clip Fasteners: Stainless steel or with corrosion-resistant coating with washers. Manufacturer's panel clips spaced according to Structural Engineer's calculations as instructed for wind uplift requirements. Screw placement and spacing for wind uplift rating requirements and design specification for application, in length necessary to penetrate substrate minimum ¾" as supplied by Metal Roof Panel Manufacturer.
12. Concealed supports, angles, plates, accessories and brackets: gauge and finish as recommended and furnished by Manufacturer.

13. Accessory Screw: Size and screw type as provided by Metal Panel Manufacturer for each use, with prefinished, high-domed “ZAC” Type hex washer head in color to match panels where exposed to view.
14. Rivets: Full stainless steel, including mandrel, in size to match application.
15. Weather Seal: Manufacturer’s approved weather seal applied continuously along locking seam prior to seaming.
16. Panels must be furnished and installed in continuous lengths from ridge to eave with no overlaps.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: All self-tapping / self-drilling fasteners, bolts, nuts, self-locking rivets and other suitable fasteners shall be designed to withstand specified design loads.
1. Use long life fasteners for all exposed fastener applications.
2. Provide fasteners with a factory applied coating in a color to match metal roof system application.
3. Provide neoprene washers under heads of exposed fasteners.
4. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.
5. Fasteners used to attach metal “Z” purlins shall be size and type recommended by Manufacturer to achieve FM 1-90 requirements.

B. Accessories:
1. General: Provide all components required in accordance with the metal roof system Manufacturer’s approved shop drawings for a complete metal roof system to include panels, panel clips, trim / flashing, fascias, ridge, closures, sealants, fillers, and other required items.
2. Cover Board: Glass-Faced Gypsum Roof Board equal to UL rated Type X “DensDeck Prime Roof Board w/ Eonic Technology” as manufactured by Georgia-Pacific. Stock board sizes shall be 48" x 96" x ½” or as indicated on drawings for roof assembly. Provide as required by manufacturer recommendation for project roof system(s). Approved substitute, SECUROCK by USG.
3. Polyisocyanurate Roof Insulation: (As Required) Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20 psi minimum compressive strength. Thickness shall be a minimum total of 4.4” (or size specified on drawings) and divided in two staggered layers. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.
    1. Acceptable substitute manufacturers include Atlas Roofing and Hunter Panels.
4. Waterproofing Membrane: 40 mil thick SBS modified bituminous product of self-adhering type with non-stick surface conforming to Grace Ice and Water Shield HT, Soprema HT underlayment, Carlisle WIP 300 HT underlayment or Architect approved equal.
5. Prefabricated Roof Curbs and Equipment Supports, Roof Jacks, and Rooftop Walkways: Shall be product of Manufacturer approved by the metal roof system Manufacturer and as specified below. Curbs shall be type recommended by roofing Manufacturer to warranty curb and roofing for 20 years.
6. Closures: All outside closures shall be fabricated from Galvalume® sheet steel of the same gauge, finish and color as the panels. Galvanized base is unacceptable.
7. Tape Seal: Pressure sensitive, 100 percent solids, polyisobutylene compound sealing tape with a release paper backing. Provide permanently elastic, non-sagging, non-toxic, non-staining tape seal approved by the metal roof system Manufacturer.

8. Joint Sealant: One-part elastomeric polyurethane sealant approved by the metal roof system Manufacturer.
9. Splash Pans and Splash Blocks: Shall be as specified in Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

2.4 PANEL FABRICATION

A. Material shall be in-line tension leveled prior to roll forming panel profile.

B. Roll form panels in continuous lengths, full length of detailed runs.

C. Standard panel length shall be 45 feet, unless approved by the metal roof system Manufacturer.

D. Fabricate trim / flashing and accessories to detailed profiles.

E. Fabricate trim / flashing from same material as panel.

2.5 PREFABRICATED ROOF CURBS AND EQUIPMENT SUPPORTS

A. General: Comply with loading and strength requirements as indicated where units support other work. Coordinate dimensions of curbs and supports with equipment supplier/manufacturer.

B. Fabricate curbs of structural quality 0.080 inch aluminum, factory baked finished after fabrication in coating compatible with and matching roof panel finish, with mitered and continuously welded corner joints. Provide integral base plates and water diverter crickets. Front base plate shall be a minimum of 18 inches from beginning of water diverter. Curbs shall be designed to install under metal roof system on the high side and over the metal roof system on the low side.

C. Curbs shall be of size and design shown on the drawings or required, with minimum height of eight (8) inches above finished metal roof system.

D. Curbs shall be constructed to match slope of roof and provide a level top surface for mounting equipment in a level horizontal position, unless shown otherwise.

E. Curb flanges shall be constructed to match configuration of roof panels.

F. Coordinate work with mechanical installer to ensure matching finish of curbs provided for roof mounted mechanical equipment.

2.6 PREFABRICATED ROOF JACKS

A. Pipe flashings shall be one piece EPDM (ethylene propylene diene monomer) molded rubber boot having a serviceable temperature range of minus 60 degrees F to 270 degrees F and shall be resistant to ozone and ultraviolet rays. Units shall have an aluminum flanged base ring.

B. Provide high temperature rated rubber roof jacks at hot stacks as applicable, including but not limited to boiler flues, heater vents, steam relief, or similar conditions. Rating minimum of 400 degrees F.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspect installed work of other trades and verify that such work is complete to a point where this work may continue.

B. Verify that installation may be made in accordance with approved shop drawings and Manufacturer's instructions. This specifically includes verifying the secondary structurals and/or decking are installed to meet building code requirements. Coordinate with metal roof system Manufacturer to insure that reduced clip spacings at eave, rake, ridge and corner areas are accommodated. Supply calculations, sealed by a professional engineer licensed in the State of Texas, showing required clip spacings.

C. Discrepancies:
1. Bring discrepancies to the attention of the Architect.
2. Do not proceed with installation until discrepancies have been resolved.

3.2 INSTALLATION OF METAL ROOFING OVER METAL DECK

A. Install metal deck to structure to meet ASCE-7 wind uplift requirements.

B. Install metal roof system so that it is weathertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction. Isolate dissimilar metal contact with proper taping and / or coatings.

C. Coordinate Work, with installation of other associated Work, to ensure quality application.

D. Coordinate Work with installation of associated metal flashings and building walls.

E. Coordinate Work to minimize foot traffic and construction activity on installed finished surfaces.

F. Install substrate boards, hat channels, purlins, or furring channels in accordance with Manufacturer’s recommendations.

G. Install insulation over metal deck in conformance with approved shop drawings and Manufacturer's instructions.

H. Install substrate board over insulation in conformance with approved shop drawings and Manufacturer's instructions.

I. Install waterproofing membrane barrier over substrate board in conformance with approved shop drawings and Manufacturer's instructions. Lap and tape seal all joints in accordance with Manufacturer’s instructions.

J. Install one layer of minimum 18” wide (each roof plane) underlayment / waterproofing membrane in valleys, eaves, rakes, hips and ridges prior to installation of the field underlayment / membrane.

K. Remove protective strippable plastic film covering from metal roof panels, trim, and related items in accordance with Manufacturer's instructions.

L. Install metal roof panels, trim, and related items in accordance with approved samples with approved shop drawings and Manufacturer's instructions.

M. Provide concealed anchors at all panel attachment locations.

N. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated.

O. Install roof jacks in accordance with approved shop drawings and Manufacturer's instructions. Install roof jacks in flat of the roof panel. Coordinate location so roof panel seams are not altered.

P. Install roof curbs in accordance with approved shop drawings and Manufacturer's instructions. Anchor curbs securely in place with provisions for thermal and structural movement. Provide prefinished metal cover around all curbs to match color and finish of metal roof panels.

Q. Install gutters and downspouts in accordance with approved samples with approved shop drawings and Manufacturer's instructions. Gutter design for required gutter and downspout sizes shall be submitted prior to installation.

R. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (10) feet on center.

S. Install splash pans and splash blocks under discharge port of downspouts. Install splash pan over a protection (walkway) pad for downspouts located at roof level.

T. Install gutter screen over installed gutter. Secure screen to spacer with self-tapping screw.

U. Provide expansion joints on ends of gutters spaced maximum 50 feet on center. Install snap-on cover over expansion joint.

3.3 CLEANING AND PROTECTION

A. Remove scraps and debris and leave work area clean.

B. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on prefinished metal by painting with a compatible paint in color to match undamaged finish.

C. Clean other work damaged or soiled by Work of this Section.

D. Protect finished work from damage.

3.4 INSPECTION

A. Architect and Contractor reserve the right to inspect the work during application. Upon completion of the work, if inspection discloses that roofing is not in accordance with this specification or has been damaged, Contractor agrees to furnish additional materials necessary to make repairs and place work in an acceptable condition at no additional expense to Owner.

END OF SECTION

SECTION 07 42 13 - METAL WALL AND SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

G. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes: Requirements including but not limited to:
   1. Concealed fastener metal wall panels as part of the assembly.
   1. Modular metal wall panel system consisting of aluminum panels in a rainscreen application.
   2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of metal composite wall panels as part of curtainwalls and aluminum storefront systems to design and coordinate the cladding assembly using performance requirements and design criteria indicated.

1.4 SYSTEM REQUIREMENTS

A. Modular Metal Panel System: Rainscreen design consisting of dry seal joinery designed, attachment system components, and associated necessary to minimize water penetration and induce air circulation in the space behind the panel system. Moisture weeping trim at panel base details allows water to drain out of the system.

1.5 SUBMITTALS

A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings: Provide shop drawings prepared by manufacturer or manufacturer's authorized dealer. Include full elevations showing openings and penetrations. Include details of each condition of installation and attachment. Provide details at a minimum scale 3-inch per foot of all required trim and extrusions needed for a complete installation.
   1. Include data indicating compliance with performance requirements.
   2. Indicate points of supporting structure that must coordinate with modular metal panel system installation.

C. Samples:
   1. One (1) ft long sample of each listed panel, including clips (if applicable) & fasteners
   2. Minimum 2" x 4" chip of specified finish.

D. Qualification Information: For Installer and Installer's field supervisor.

E. Sample Warranties: Submit proposed warranty meeting requirements of this Section.

1.6 DELIVERY AND STORAGE

A. All panels shall be delivered with appropriate packaging to provide protection against transportation damage. Materials damaged in shipping or storage shall not be used.

B. Store all materials and accessories above ground on well-skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between panels.

1.7 COORDINATION

A. Coordinate work with installation of associated metal flashings and manufactured roof panels.

B. General contractor shall coordinate with all subcontractors including masonry, waterproofing membrane, sheathing work, and framing to ensure walls are plumb and ready to accept fasteners and panel systems.

C. Pre-construction meeting required with owner and architect. Representatives from all associated trades shall attend to coordinate arrival, delivery, and installation of products and materials.

1.8 WARRANTY

A. Warrant the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship.

B. Provide a manufacturer's twenty (20) year finish integrity warranty.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

A. Basis of Design Manufacturer: PAC-CLAD / Petersen Company; Tyler, TX, (800) 441-8661. Other manufacturers may bid on this project provided they comply with all requirements of this specification. Product listed is considered basis of design and owner shall not be responsible for any costs resulting from change of manufacturer including sizes, trim pieces, structural, or system components. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
   1. Alcoa, New York, NY (800) 841-7774.
   2. CENTRIA Architectural Systems; Township, PA (800) 759-7474.
   3. MBCI, Houston, Tx, (281) 445-8555.
   4. Berridge Manufacturing Company; Houston, TX, (800) 231-8127

2.2 MATERIALS

A. Concealed Fastener, Corrugated (**MWP-2**):
   1. Prefinished Sheet Material: 22-gauge thick Galvalume® steel sheet, minimum yield 50,000 PSI, roll formed in continuous lengths, ASTM A792.
   2. Rib Height: 1.375"
   3. Finish: Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000

finish supplier. Color shall be as selected by Architect from manufacturer's available colors. Interior surface finish shall be manufacturer's standard color.

4. Touch-up Paint: Paint burns, scars, welds, and damaged and rusted surfaces with cold galvanizing paint in accordance with ASTM A780. Acceptable Products include ZRC Cold Galvanizing Compound or Galvilite manufactured by ZRC Worldwide, Marshfield, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawerence, MA; or paint complying with military specification MILP-21035A, Type I or II.
5. Strippable Film: Shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.
6. Accessories:
   1) Sealant: As specified in Section 07 92 00.
   2) Cold Formed Metal Framing: As specified in Section 05 40 00.
   3) Girts, Sub-girts, purlins: 16 gauge minimum thickness (55,000 psi minimum yield thickness) galvanized steel, with Stainless Steel screws to meet application.
   4) Fasteners: long-life, corrosion resistant screws supplied or instructed by panel manufacturer to suit application spaced according to UL requirements, color matched to match metal panel color.
   5) Clips, miscellaneous fasteners: galvanized steel as supplied or instructed by panel manufacturer.
   6) Metal Trim, closures, and flashing: Exposed adjacent flashing shall be the same material and finish as panel system.
   7) Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.
   8) Dampproofing: refer to section 07 11 00.
7. Approved Product/Manufacturer: PAC-CLAD; **Box Rib 3 (MWP-2)** and **Box Rib 4 (MWP-2)**, or Architect approved equal.
8. Color: PAC-CLAD "INKWELL".

B. Flush Wall Panels **(MWP-1, MWP-3, MWP-4)**:
   1. Basis of Design Product: (**MWP-1)** Flush Panel - Wall panel manufactured by PAC-CLAD / Petersen Company.
   2. Basis of Design Product: (**MWP-3, MWP-4)** Reveal Panel - Wall panel manufactured by PAC-CLAD / Petersen Company.
   2. Metallic–Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
      a. Nominal Thickness: 0.050 inch
      b. Panel width: 12" O.C.
      c. Surface: Smooth, flat finish. (MWP-1)
      d. Surface: Reveal, flat finish. (MWP-3,MWP-4)
      e. Exterior Finish: Metallic Two Coat fluoropolymer
      f. Color: "**TBD**".

C. Flat Seam Soffit Panels **(MWP-5)**:
   1. Basis of Design Product: Soffit panel manufactured by PAC-CLAD / Petersen Company.
   2. Metallic–Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
      g. Nominal Thickness: 0.024 inch (0.61 mm).
      h. Surface: Smooth, flat finish.
      i. Exterior Finish: Metallic Two Coat fluoropolymer
      j. Color: "**TBD**".

D. All Cold-Formed Metal Framing for Metal Wall and Soffit Panels to be designed by a Texas Licensed Profession Engineer per spec. Section 05 40 00.
Professional Engineer

E. Accessories:
1. Zees: 16 gauge minimum thickness galvanized steel, 2 inch rise minimum, or as required to align with existing conditions.
2. Sub-Girt Fasteners: Stainless Steel screws to meet application.
3. Concealed Fasteners: Stainless Steel screws supplied or recommended by panel manufacturer to suit application.
4. Metal Trim at Siding Panels: 0.060 inch thick pre-finished aluminum sheet, matching finish type and color of siding panels.
5. Closures: 0.060 inch thick aluminum sheet, mill finish.
6. Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.
7. Air Barrier: High temperature air barrier. Re: 07 26 00.
8. Polyisocyanurate: Shall comply with NFPA 285 & ASTM G 2357 & ASTM E 331. Thickness shall be 2-inch.
9. Access Panels: Refer to 08 31 13 Specification.

PART 3 - EXECUTION

3.1 EXAMINATION OF MODULAR METAL PANEL SYSTEM

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
a. Verify that air or water resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel as required by manufacturer's written recommendations.

3.3 SOFFIT PANEL INSTALLATION

A. Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air or water resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe and conduit penetrating panels.

B. Fasteners:
   1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
   1. Include attachment to supports, panel to panel joinery, panel to dissimilar material joinery, and panel system joint seals.

E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
   1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00.
   2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
   3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed and returned flanges of wall panels to panel clips with standard fasteners.
   1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00.
   2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.

G. Subgirt and Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt and spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
   1. Install wall panels to allow individual panels to free float and be installed and removed without disturbing adjacent panels.

2. Do not apply sealants to joints unless otherwise indicated.

H. Track Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
   1. Attach routed and returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
   2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
   3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   4. Do not apply sealants to joints unless otherwise indicated.

I. Rainscreen Principle Installation: Install using assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
   1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
   2. Do not apply sealants to joints unless otherwise indicated.

J. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; provide types recommended in writing by metal composite material panel manufacturer.

K. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA *Architectural Sheet Metal Manual*. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
   1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.3 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated, and within 1/8 inch (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.

B. Water Spray Test: After installation, test area of assembly directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer Field Service: Engage a factory authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

D. Metal composite material wall panels are considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

This page intentionally left blank

SECTION 07 42 13 – METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Aluminum faced composite panels with mounting system. Panel mounting system including anchorages, shims, furring, fasteners, gaskets and sealants, related flashing adapters, trim pieces, reveals, and masking (as required) for a complete watertight installation.

B. Concealed-fastener, lap-seam metal wall panels.

C. Coping, column covers, soffits, sills, border, and filler items indicated as integral components of the panel system or as designed.

1.3 RELATED SECTIONS

A. Section 01 60 13 – Exterior Design Selections.

B. Section 05 12 00 – Structural Steel Framing.

C. Section 07 21 00 – Thermal Insulation.

D. Section 07 55 52 - Modified Bituminous Membrane Roofing System.

E. Section 07 62 00 - Sheet Metal Flashing, Gutters, Downspouts and Trim.

F. Section 07 92 00 - Joint Sealants.

G. Section 09 21 16 – Gypsum Board Assemblies.

1.4 SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Samples
   1. Panel System Assembly: Two samples of each type of assembly. 304mm (12") x 304mm (12") minimum.
   2. Sample color chain with full range of manufacturer's colors.
   3. Two samples of each color or finish selected, 76mm (3") x 102mm (4") minimum.

C. Shop Drawings
   1. Submit shop drawings showing project layout and elevations; fastening and anchoring methods; detail and location of joints, sealants, and gaskets, including joints necessary to accommodate thermal movement; trim; flashing; and

accessories.

D. Affidavit certifying material meets requirements specified.

E. Two copies of manufacturer's literature for panel material.

F. Code Compliance
1. Documents showing product compliance with the national and local building code shall be submitted prior to the bid. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product.

G. Alternate materials must be approved by the architect prior to the bid date.

1.5 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.6 REFERENCES

A. Aluminum Association
1. AA-C22-A41: Anodized - Clear Coatings.
2. AA-C22-A42: Anodized - Integral Color Coatings.

B. American Architectural Manufacturers Association
3. AAMA 508-05: Voluntary Test Method and Specification for Pressure Equalized Rain
4. Screen Wall Cladding Systems

C. American Society For Testing And Materials
5. E 330 Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the
6. Influence of Wind Loads
7. E 283 Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
8. D 1781 Climbing Drum Peel Test for Adhesives
9. E 84 Surface Burning Characteristics of Building Materials
10. D 3363 Method for Film Hardness by Pencil Test
11. D 2794 Resistance of Organic Coatings to the Effects of Rapid Deformation
12. (Impact)
13. D 3359 Methods for Measuring Adhesion by Tape Test
14. D 2247 Practice for Testing Water Resistance of Coatings in 100% Relative
15. Humidity
16. 9. B 117 Method of Salt Spray (Fog) Testing
17. 10. D 822 Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for
18. Testing Paint, Varnish, Lacquer, and Related Products
19. 11. D 1308 Effect of Household Chemicals on Clear and Pigmented Organic Finishes
20. 12. D 1735 Method for Water Fog Testing of Organic Coatings.
21. 13. D 1929 Standard Test Method for Determining Ignition Temperature of Plastics
22. 14. D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of
23. Plastics in a Horizontal Position

1.7 QUALITY ASSURANCE

A. Composite Panel Manufacturer shall have a minimum of 20 years' experience in the manufacturing of this product.

B. Composite Panel Manufacturer shall be solely responsible for panel manufacture and application of the finish.

C. Fabricator/Installer shall have a minimum of 5 years' experience of metal panel work similar in scope and size to this project and shall be acceptable to the composite panel manufacturer.

D. Field measurements should be taken prior to the completion of shop fabrication whenever possible. However, coordinate fabrication schedule with construction progress as directed by the Contractor to avoid delay of work. Field fabrication may be allowed to ensure proper fit. However, field fabrication shall be kept to an absolute minimum with the majority of the fabrication being done under controlled shop conditions.

E. Shop drawings shall show the preferred joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on the inside face of the panel system as determined by ASTM E 331. Systems not utilizing a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated System) shall provide a means of concealed drainage with baffles and weeps for water which may accumulate in members of the system.

F. Maximum deviation from vertical and horizontal alignment of erected panels: 6mm (1/4") in 6m (20') non-accumulative.

G. Panel fabricator/installer shall assume undivided responsibility for all components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.

H. Composite panel manufacturer shall have established a Certification Program acceptable to the local Code Authorities.

1.8 DELIVERY AND STORAGE

A. All panels shall be delivered with appropriate packaging to provide protection against transportation damage. Materials damaged in shipping or storage shall not be used.

B. Store all materials and accessories above ground on well-skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between panels.

1.9 COORDINATION

A. Coordinate work with installation of associated metal flashings and manufactured roof panels.

1.10 WARRANTY

A. Warrant the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming

materials or workmanship.

B. Provide a manufacturer's twenty (20) year finish warranty and a manufacturer's twenty (20) year no leak warranty.

PART 2 - PRODUCTS

2.1 METAL COMPOSITE PANELS - EXTERIORS

A. Basis of Design: Product by **ALUCOBOND® PLUS** material manufactured by 3A Composites USA. (800) 626-3365 or (270) 527-4200. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
1. Centria Architectural Systems, Houston, TX (832) 868-1634. 2. Alcoa, New York, NY (800) 841-7774.
3. Larson Alucoil, Frisco, TX (972) 473-2074.

B. Thickness: 4MM (0.157")

C. Schedule:

1. **MCM-1**– Graphic Mica (low canopy).
2. **MCM-2**– Market Pearl White Mica (high canopy).
3. **MCM-3**– Fire Red (wall panel).

D. Composition: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.

E. Aluminum Face Sheets: 0.50mm (0.0197") (nominal), AA5000 Series (Anodized material).

F. Soffit Panels: Vented thickness as recommended by Manufacturer of wall panels, aluminum. Manufacturer shall be the same as wall panel manufacturer.

G. System Type: Rear Ventilated Rain Screen. System must provide a reveal joint as detailed on drawings. Provide moisture barrier and sheathing as shown on drawings.

H. Accessories:
1. Sub-Girts: .050 minimum thickness aluminum, 3/4-inch rise minimum, or as required to align with adjacent finishes.
2. Sub-Girt Fasteners: Stainless Steel screws to meet application.
3. Concealed Fasteners: Stainless Steel screws supplied or recommended by panel manufacturer to suit application.
4. Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.
5. Waterproofing Membrane: 40 mil thick fully adhered (TAMKO TW-40 or approved equal); provide with primers, adhesives and accessories as recommended by manufacturer to suit application.

6. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
7. Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
8. Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.

9. Fabricate flashing materials from 0.030" minimum thickness aluminum sheet painted to match the adjacent curtain wall / panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.
10. Fasteners (concealed/exposed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.
11. Reveals, joints, intersecting pieces, edges, and miscellaneous trim as required and as shown in drawing elevations furnished in secondary color to be selected by architect in varying sizes, widths, shape, form, etc.

I. Panel Layout: Manufacturer shall allow in their bid proposal for new composite panels at the Field House to have a layout/pattern to be determined later. For budgeting purposes allow a layout of medium complexity horizontal/vertical straight-line geometry and symmetrical layout of panels in no more than three (3) modular size panels with reveals and trim pieces typical of type of system. Panels shall be a mix of three color (TBD) selections and reveals shall be a different (TBD) color. Coordinate layout/pattern as approved and provided by architect before or during submittal phase.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine metal frame to insure it is prepared to receive siding.

B. Ensure substrates are flat, free from objectionable warp, wave and buckle

3.2 INSTALLATION OF SIDING PANELS

A. Install sub-girts at 24 inches on center (vertical max.), at least three per panel length. Fasten girts to wall with two fasteners at 18 inches on center max.

B. Comply with manufacturer’s instructions for assembly, installation and erection to achieve weathertight installation.

C. Install waterproof membrane behind sub-girts. Seal all laps.

D. Fasten siding panels along each sub-girt.

E. Install closures and trim to form a complete installation.

F. Install sheet metal flashings according to provisions of Section 07 62 00.

3.3 PROTECTION

A. Protect roofing, siding, soffits, and all metal pieces from damage and discoloration.

B. Repair or replace all damaged or discolored panels and pieces at no added cost to owner.

C. Factory applied protective sheeting to remain on panels during transit, storage, and installation to protect materials for duration of construction. Remove and discard all protective coverings following installation only when authorized by owner/architect.

END OF SECTION 07 42 13.13

This page intentionally left blank

SECTION 07 52 19 - MODIFIED BITUMEN MEMBRANE ROOFING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Providing coordination for the entire roofing assembly, including, but not limited to:
   1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
   2. Modified bitumen membrane roofing
   3. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00).
   4. Work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.

B. It is the intent of this Section that the Work shall:
   1. provide a watertight facility;
   2. conform to all applicable building code requirements and of authorities having jurisdiction;
   3. include Section 07 62 00, Roof Related Sheet Metal as part of the Work of this Section; and be performed to obtain a single responsibility total system warranty.

C. Work and materials hereinafter specified shall be best of kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one (1) manufacturer or supplier.

1.2 RELATED WORK

A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. C920, Standard Specification for Elastomeric Joint Sealants
   2. D41, Standard Specification for Asphalt Primer Used in Roofing, Damproofing, and Waterproofing
   3. D312, Standard Specification for Asphalt Used in Roofing
   4. D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
   5. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
   6. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
   7. D4601, Standard Specification for Asphalt-Coated Glass Fiber Sheet Used in Roofing
   8. D5147, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material
   9. D4897, Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
   10. D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements

B. ASCE-7 Wind uplifts requirements for geographical area.

C. Federal Specifications (FS)
1. SS-R-620B
2. TT-S-00230C

D. National Roofing Contractors Association (NRCA)
1. Roofing and Waterproofing Manual

E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual

F. International Building Code

G. Underwriters' Laboratories (UL)
1. Fire Hazards Classifications

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.

B. Certifications:
1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system.
2. Manufacturer's affidavit that materials used in Project contain no asbestos.
3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subcontractor on this project and that all workers on this project are covered by workmen's compensation.
5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
6. Manufacturer's written certification of approval / acceptance of these specifications and details.
7. Warranty: Submit letter from manufacturer signed by agent authorized to do so, stating acceptance of warranty as specified and detailed.

C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.

D. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", fourth edition.
1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

E. Samples:
1. Submit sample copy of job specific warranty that is to be issued upon project completion.

2. Submit mock-up of all fabricated sheet metal items.
3. Submit 12 inch x 12 inch sample of all types of roof membranes to be installed.

F. Temperature Charts: Bitumen heating devices 24 hour temperature charts.

G. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
1. Softening Point: ASTM D312.
2. Flashpoint: ASTM D92.
3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
4. Thermometers: Two (2) hand held, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.

H. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
2. Maintenance Procedures: Three (3) copies of manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.

1.5 PROJECT CONDITIONS

A. Weather Condition Limitations: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements. Roofing application with moisture present will not be accepted. Do not attempt construction of the roofing system when the reported or calculated dew point are within three (3) degrees of each other

B. Do not allow waste products, petroleum, grease, oil solvents, mineral oil, and other contaminants to come into contact with the roofing system before or during installation. Advise Owner if there is a possibility of his facility emitting such contaminants in the future.

1.6 INSPECTIONS / TESTS

A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
1. Architect Inspections: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
2. Manufacturer Inspections:
   a. An inspection shall be made by a representative of the material manufacturer a minimum three (3) times monthly during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
   b. The authorized material manufacturer's field representative shall be responsible for:
      1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.

2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.

B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.

C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
3. Non compliance with contractor requirements will result in the Architect/Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor.

1.7 QUALITY ASSURANCE

A. Applicator:
1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
5. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
6. Contractor shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
7. Roofing contractor must have reached the highest level of qualifications from the manufacture they are providing material for (i.e. Master Select contractor).

B. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
2. Roofing system shall be installed in accordance with ASCE-7 wind uplift requirements for geographical location exposure B, 110 MPH 3-second gust wind speed zone and an importance factor of 1.15 based on IBC building code

requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.

1. Zone 1 Field -73.6 psf or as otherwise indicated by Structural
2. Zone 2 Perimeter -123.4 psf or as otherwise indicated by Structural
3. Zone 3 Corner -185.8 psf or as otherwise indicated by Structural

3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

C. Texas State Board of Insurance Windstorm Regulations: Owner will provide inspector to meet all requirements. Contractors to coordinate all applicable roof inspections with Owners Inspector.

D. Laboratory Testing and Samples:
1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Contractor shall assume all costs for extraction and patch of all samples.
3. Re-tests for work which fail initial tests or contractor shall pay inspections.
4. Contractor shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.

E. Installation:
1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractor’s Association.
3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.
4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all contractors’ equipment and materials removed from the site.

1.8 PERFORMANCE REQUIREMENTS

A. Texas State Board of Insurance Windstorm Regulations: Owner will provide inspector to meet all requirements. Contractors to coordinate all applicable roof inspections with Owners Inspector.

B. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.

C. Contractor shall ensure that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

1.9 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. Coordinate material storage with school Principal.

B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.

C. Products liable to degrade as a result of being frozen shall be maintained above 40 degrees F in heated storage.

D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.

E. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.

F. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.11 PRECAUTIONS

A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

B. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.

C. If torches are used, Contractor shall maintain a three (3) hour fire watch after completion of torching of each day’s work. Provide a 20 lb. fire extinguisher near torch at all times. Use a thermal infrared thermometer to monitor all roof areas.

D. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above mentioned items.

1.12 WARRANTY

A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
1. The warranty shall be a NDL “No Dollar Limit” / no penal sum type, with total replacement cost.
2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
3. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.

B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.

C. Make arrangements with the materials manufacturer to provide required inspections for issuance of warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer.

B. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.

C. All materials used on the project shall be asbestos free.

2.2 APPROVED PRODUCTS/MANUFACTURERS

A. Unless noted otherwise, specifications are based on products of manufacturers listed below. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions. The following are pre-approved optional manufacturers.

1. GAF Wayne, NJ (800) 766-3411
2. Soprema, Wadsworth, OH; (800) 356-3521
3. Siplast, Inc., Irving, TX; (800) 922-8800
4. JM Denver, Colorado (800) 922-5922
5. Firestone Building Products Company, Carmel, IN (800) 428-4442

2.4 ROOFING SYSTEM ASSEMBLY / UNDERLAYMENT DESCRIPTION

A. Base Sheet: Shall be a heavy duty (plus) base sheet or venting base as approved by proposed manufacturer.
   a. GAF: GAFGLAS #75 pound, base sheet
   b. Soprema Product: Sopra-G, base sheet
   c. Siplast Product: Para Base, base sheet
   d. JM Product: Perma Ply 28, base sheet
   e. Firestone Product: SBS Base, base sheet

B. Dry Sheathing Paper: (For use as a slip sheet when needed) Rosin coated, 5 lbs per 100 SF.

2.5 ROOF MEMBRANE ASSEMBLY / SYSTEM DESCRIPTION

A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Contractor option to install using hot asphalt “mopped”, cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.
   1. Modified Bitumen Base Ply: A high performance modified bitumen base ply consisting of a reinforcing mat impregnated and coated with high quality modified bitumen: (Coordinate with manufacturer for special membrane type requirements when installed over insulation.)
      a. GAF: Ruberroid 20 FR
      b. Soprema Product: Elastophene
      c. Siplast Product: Paradiene 20
      d. JM Product: DynaBase
      e. Firestone Product: SBS Base

   2. Modified Bitumen Finish Ply: A high performance modified bitumen finish ply consisting of a reinforcing mat impregnated and coated with high quality modified bitumen, and surfaced with white ceramic granules:
      a. GAF: Ruberoid 30 FR
      b. Soprema Product: Elastophene FRGR
      c. Siplast Product: Paradiene 30 FR
      d. JM Product: DynaGlas FR
      e. Firestone Product: SBS FR Cap

   3. STRIPPING PLY: Same as Modified Bitumen base ply.

2.6 FLASHING MEMBRANE ASSEMBLY

A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified asphalt membrane (foil face flashing membrane can be used as substitute):
   1. Modified Bitumen Flashing Sheet:
      a. GAF: Ruberoid 30 FR
      b. Soprema Product: Elastophene FRGR
      c. Siplast Product: Paradiene 30 FR
      d. JM Product: DynaGlas FR
      e. Firestone Product: SBS FR Cap

   2. Modified Bitumen Foil Faced Flashing Sheet (Substitute):
      a. GAF: Ruberoid Ultraclad
      b. Soprema Product: Sopralast 50 TV “Alu”
      c. Siplast Product: “Aluminum” Veral
      d. JM Product: DynaClad AL
      e. Firestone Product: SBS Metal Flash AL

   3. Reinforcing PLY: Same as roof system base ply.

2.7 All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.8 ROOFING SHEET METAL

A. Refer to Section 07 62 00, Roof Related Sheet Metal.

2.9 ROOF INSULATION

A. Roofing Insulation:
   1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
   2. Polyisocyanurate Roof Insulation: (As Required) Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20 psi minimum compressive strength. Thickness shall be a minimum total of 4.4” (or size specified on drawings) and divided in two staggered layers. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.
      a. Acceptable substitute manufacturers include Atlas Roofing and Hunter Panels.
   3. Cover Board: Glass-Faced Gypsum Roof Board equal to UL rated Type X “DensDeck Prime Roof Board w/ Eonic Technology” as manufactured by Georgia-Pacific. Stock board sizes shall be 48" x 96" x ½” or as indicated on drawings for roof assembly. Provide as required by manufacturer recommendation for project roof system(s). Approved substitute, SECUROCK by USG.
   4. Polyisocyanurate Tapered Roof Insulation: (As Required) Shall comply with ASTM C1289 Type II Class 2, Grade 2 with inorganic coated glass facer on both sides, with a 20 psi minimum compressive strength. Provide factory cut 48” x 48” stock board. Slope and thickness to vary as required to achieve a minimum ¼”

per foot finished slope unless noted otherwise on the Drawings (cricketed areas between roof drains / scuppers are to achieve a minimum ½" per foot slope). Provide ½" cover board similar to that specified above tapered polyisocyanurate board insulation. Basis of specification shall be ENRGY 3 CGF as manufactured by Johns Manville.

a. Acceptable substitute manufacturers include Atlas Roofing and Hunter Panels.

5. Tapered "Fesco" Edge Strip: 0" to 1½" tapered (or as required for field conditions), 18" wide x 48" long. Install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Basis of specification shall be as manufactured by Johns Manville or approved substitute.

2.10 ROOFING ACCESSORIES

B. Roofing Adhesives:

1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
   a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
2. Cold Adhesive (if applicable): An asphalt based adhesive formulated especially for adhering polymer modified asphalt roofing membranes and base plies. Adhere shall be UL & FM listed and approved.
   a. GAF Product: Matrix
   b. Soprema Product: FMA
   c. Siplast Product: PA-311 Adhesive
   d. Firestone Product: MB Cold Adhesive

C. Bituminous Cutback Materials:

1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
2. Plastic Cement: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
3. Flashing Cement: A heavy-bodied all-weather trowel grade mastic, used as a base for laying-up cold process flashing membrane where fast setting adhesives are required.

D. Sealants: A single component, high performance, elastomeric sealant conforming to ASTM D232 or ASTM C920 requirements. Acceptable types are as follows:

1. Sonolastic NP 1 manufactured by Sonneborn Building Products; Minneapolis, MN (612) 835-3434

D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.

E. Walkpads / Protection Pads: Provide cut sections of granule surfaced polyester reinforced modified bitumen sheet, such as "Dyna Tred Plus".

1. Walk pads shall have contrasting granule color from surfacing.
2. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.

3. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
4. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.

F. Fasteners:
1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
3. Fastener for Wood and Insulation (over steel decks): Shall be a minimum #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal. Stainless Steel 304 when used with ACQ treated lumber.
4. Nails: Stainless Steel ring shank, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head.
5. Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215 inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wing span, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.

2.9 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.
1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. “Red Line” Low level expansion joint details. Install as per manufactures recommendations.
   a. Approved Substitute Soprema’s “Sopra Joint”. Install as per manufactures recommendations.
3. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07 72 00, Roof Accessories.
5. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
6. Termination Bar:
   a. Material: Extruded aluminum bar with lip profile.

b. Size: 0.090 inch thick by 3/4 inch wide with 3/16 inch lip width and a 45 degree lip angle, factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
c. Approved Product/Manufacturer: “LIPTB 06” manufactured by Olympic Manufacturing Group, Inc., or approved equal.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Environmental Requirements:
1. Apply roofing in dry weather.
2. Do not apply roofing when ambient temperature is below 45 degrees F.
3. Refer to manufacturers recommendations.

3.2 ROOFING AND FLASHING - GENERAL

A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow installation of insulation as a continuous operation.

B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials and exercise care in ensuring that the finished application is acceptable to the Owner.

C. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.

D. General Installation:
1. Protect adjacent areas with tarpaulin or other durable materials.
2. Contractor shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
3. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
4. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. All Kynar 500 or Hylar 5000 finished metal shall be buff sanded on the surface which is to be primed prior to the application.
5. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
6. All surfaces/substrates shall be clean and dry prior to application of materials. Roof deck substrates shall be inspected for moisture in accordance with the manufacturer’s recommendations. Architect’s representative shall witness inspection. Roofing installed before inspection by Architect’s representative shall be removed to allow inspection.
7. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
8. Ambient temperature shall be 45 degrees F and rising.

9. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Kettle shall be kept a minimum of 20 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle. All kettles are to have afterburners installed to reduce fume emissions.
10. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with equiviscous temperature method ("EVT Method") as recommended by the manufacturer. Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.
11. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
12. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
13. Membrane Adhesive Application: Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1-1/2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion.)
14. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
15. Circulate bituminous materials, do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers.
16. Keep kettle lid closed except when adding bitumen.
17. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying felt and membrane.
18. Dry voids of felt on felt are not acceptable.
19. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
20. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge, and be a minimum of eight (8) inches in height above the finished membrane height.
21. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
22. Correct all errors in application the same work day they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage and all work not meeting specifications.
23. Follow manufacturer’s recommendation for application of cold adhesive due to slope requirements.

3.3 NAILERS

A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building in accordance with FM Global 1-49 securement requirements. All deck penetrations (soil stacks, mechanical curbs, etc.) shall receive wooden nailers stacked minimum 3/4 inch above designed deck thickness. MCA and MCQ only.

B. All Construction: Nailers shall be the same height as the finished height of the insulation layer. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum or as required by FM Global 1-49 requirements. Provide nailers at all penetrations. Install/Raise all curbs, etc, a minimum of ten (10) inches above roof deck.

3.4 SUBSTRATE PREPARATION

A. Ensure decking to receive insulation is clean (including flutes), dry, even and properly secured.

B. Structural concrete decks shall have existing fully adhered roof membrane removed to the greatest extent possible and without exception all loose, poorly bonded roofing plies, dirt, dust and debris shall be removed completely.

3.5 APPLICATION OF BASE SHEET

A. Lightweight concrete deck shall be covered with a base sheet, mechanically fastened as follows:
   1. Install in accordance with manufacturer's current published application instructions and to meet ASCE-7 wind uplift requirements. Fasteners and fastening patterns shall be determined by building height, pull out values from lightweight insulating concrete decks (more stringent applies), location and geographical area of the United States. It is the contractor's responsibility to consult current ASCE-7 publications, literature, and bulletins that are in effect at the time of this project. Submit perimeter, field and corner fastening patterns and cite all ASCE-7 data pertaining to the fastening pattern to the Architect for review.

3.6 APPLICATION OF INSULATION

A. General:
   1. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application.
   2. Precautions: The surface of the insulation must not be ruptured or damaged prior to installation of the roof membrane. Replace damaged boards.
   3. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
   4. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
   5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
   6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required NRCA standards.

B. (Steel decks); Specified rigid insulation shall be mechanically fastened to the steel deck meeting ASCE-7 wind uplift requirements as dictated by wind zone applicable to location of project. Fasteners and fastening patterns shall be determined by building height, location and geographical area of the United States. It is the contractor's responsibility to consult

current publications, literature, and bulletins of current codes and the manufacturer that are in effect at the time of this project.

C. For subsequent layer or layers of insulation or specified recovery board, the top surface of the underlying layer of insulation shall be coated with hot asphalt using a minimum of twenty-five pounds (25#) per one hundred (100) square feet of surface, and subsequent layers of insulation shall be applied using offset joints, so that all individual insulation layers joints are offset a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.

3.7 ROOF MEMBRANE INSTALLATION

A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.

B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.

C. Adhesive Application: Apply cold adhesive with a spray equipment or squeegee in a smooth even, continuous layer without breaks or voids at the rate of 1 ½ to 2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion. Refer to manufacturer’s requirements.)

D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

E. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.

1. Apply all layers of roofing so that water flows over or along lap seams, but never against laps.
2. Mechanically attached and heat weld the seams or fully bond the base ply to the recover board with cold adhesive, torch, hot asphalt. Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps a minimum of three (3) feet.
3. Fully bond the finish ply to the base ply with cold adhesive, torch, or hot asphalt. Each sheet shall have a minimum of three (3) inch side and six (6) end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.

5. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.

F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color and adhesion.

3.8 ROOF FLASHING MEMBRANE INSTALLATION

A. Flashing - General:
1. Flashings shall be installed using the manufacturer's flashing membrane, with length of run not to exceed manufacturer's recommendations.
2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade wolmanized timber, and of the same thickness as any insulation to be used on the roof.
3. Cant strips shall be installed at the intersection of the deck and/or all vertical surfaces. Prime all cants.
4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height (seal top with three (3) coursing), extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
7. Install flashing membrane in accordance with drawings and/or material manufacturer's guarantee requirements, whichever is the most stringent.
8. Exert sufficient pressure on the flashing membrane to ensure the prevention of air pockets. This can be accomplished by using a damp, kitchen type sponge mop or a damp, heavy duty cotton nap paint roller.
9. Prime all end laps of the flashing membrane with a uniform coating of the specified asphalt primer and allow to thoroughly dry prior to overlapping of adjoining sheets.
10. Probe laps using a clean, heated roofing trowel and heat fuse dry laps of the flashing membrane to ensure a complete seal.

B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and

seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)

C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)

D. Projection Flashings:
1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack, and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof membrane manufacturer. Strip-in flange with specified stripping ply and cap with finish ply. Provide flashing membrane target.
2. Square Projections: Strip in all flanges on square projections with specified stripping ply and cap with finish ply. Provide flashing membrane target. Provide tapered edge strips around base. Cricket up-side slope.
3. Prime all flanges prior to setting in a bed of mastic. Install to manufacturer's specifications. Provide tapered edge strips around base as required. Cricket up-side slope.
4. Round Projections: Strip in all flanges on round projections with specified stripping ply and cap with finish ply. Provide flashing membrane target.
5. Prime all metal prior to setting in mastic. Install to manufacturer's specifications.

E. Wall and Curb Flashings:
1. The flashing substrate shall be free of all dirt and loose material.
2. ¾” plywood is to be used at all parapets that receive wall flashings.
3. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
4. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
5. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.

6. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
7. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
8. Cricket the up-side slope at all curb projections.

F. Perimeter Edge Flashing: Refer to Section 07 62 00.

G. Bleed out of flashing membrane: Broadcast bulk aluminum powder over all bitumen overruns on the flashing membrane surface while the bitumen is still hot to ensure a monolithic surface color. With approval of manufacturer, a premium glossy aluminum paint may be used.

3.9 OVERNIGHT SEAL / WATER CUT-OFF

A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.

B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.10 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.

B. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.

C. Sheet Metal: Refer to Section 07 62 00, ROOF RELATED SHEET METAL.

3.11 FIELD QUALITY CONTROL AND INSPECTIONS

A. Roof cuts shall be performed and repaired at contractor's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.

B. Remove not more than one (1) 12 inch x 12 inch cut per 5,000 square feet of roof area or fraction thereof.

C. Field audit will follow criteria outlined in current roof membrane manufacturer's Reference Manual.

D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.

E. Correct deficiencies in roof as prescribed in current roof membrane manufacturer's Reference Manual and as approved by Architect's Representative.

3.12 CLEANING AND PROTECTION

A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.

B. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.

C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.

D. Remove bitumen stains from walls, walkways, and driveways.

END OF SECTION

SECTION 07 62 00 - ROOF RELATED SHEET METAL

PART I – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. It is the intent of this Section that the Work shall:
   1. conform to all applicable building code requirements and of authorities having jurisdiction;
   2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
      a. Roof penetration sleeves and hood and umbrella counterflashing
      b. Metal counterflashing
      c. Expansion joint
      d. Roof drains
      e. Scuppers
      f. Metal perimeter edge
      g. Gutters, Downspouts, Splash Blocks and Splash Pans
      h. One-way roof moisture relief vents
      i. Metal gravity vents
      j. Metal heat exhaust vents
      k. Sanitary vent pipes
      l. Pipe box
      m. Copings, trim and miscellaneous sheet metal accessories.
   3. be part of the Work of the Roofing System; and
   4. be performed by a single source contractor.

1.3 RELATED WORK

A. Section 07 31 13 – Asphalt Roofing Shingles

B. Section 07 41 13 – Prefinished Metal Roofing

C. Section 07 52 19 - Modified Bitumen “Cool Roof” Membrane Roofing System

D. Section 07 72 00 – Roof Accessories

E. Section 13 34 19 – Pre-Engineered Metal Building System

F. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

1.4 REFERENCES

A. ASTM International (ASTM)
   1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

3. B32, Standard Specification for Solder Metal
4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. ASCE 7

C. Federal Specifications (FS)
1. QQ-L-201 for lead

D. National Association of Architectural Metal Manufacturers (NAAMM)

E. National Roofing Contractors Association (NRCA)
1. Roofing and Waterproofing Manual

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual

G. ANSI / SPRI ES-1

1.5 SUBMITTALS

A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturer's installation instructions.

B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.

C. Samples:
1) Full range of finish colors for Architect's selection.
2) 12 inch long sample of each specified item with approved finish.
3) Provide full size mockup of all shop built assemblies.
4) Documentation of Wind uplift requirements for Roof Edge for specific project location
a. Wind Calculator available online

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.

B. Comply with governing codes and regulations of authorities having jurisdiction.

C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 150 MPH wind speed zone and wind resistance loads.

1.7 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13, Project Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store materials in accordance with manufacturer's instructions.

B. Handle and store materials and equipment in such a manner as to avoid damage.

C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.9 WARRANTIES

A. Manufacturer's Product Warranty:
   1) Manufacturer's standard 30 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
   2) Failure is defined to include, but not be limited to:
      a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
   3) Wind Warranty
      a. Non Coastal: up to 160 MPH Blow Off Resistance, 20 Year
   4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
   5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.

B. Roofing Contractor's Warranty:
   1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
   2. Defects shall include, but not be limited to:
      a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
      b. Leaking water or bitumen within building or construction.
      c. Becoming loose from substrate / blocking.
      d. Loose or missing parts.
      e. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Metal Era, Inc., which is located at: 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email:request info (info@metalera.com); Web:www.metalera.com

B. Substitutions: Before proposal date upon roof consultant approval.

C. Requests for substitutions will be considered in accordance with provisions of Section 012513.

D. Manufacturers named within specification are approved for use on the Project providing:
   1. their products meet or exceed the specifications;

2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
4. products are approved for use by the roofing membrane manufacturer.

2.2 SHEET METAL MATERIALS

A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.

B. Prefinished Aluminum Sheet:
1. Precoated type, aluminum conforming to Fed. Spec. QQ-A-250, ASTM B209.
2. Thickness: Minimum 0.040 inch, except as otherwise indicated. SMACNA recommendations shall govern.
3. Finish: Kynar 500, color as selected by Architect from manufacturer's full range of standard and premium colors.

C. Prefinished Galvanized Sheet Steel:
1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of standard and premium colors.

D. Membrane Clad Sheet Steel:
1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
3. Finish: PVC / TPO coating as per Membrane Manufacturer's requirements.

E. Sheet Lead:
1. Comply with FS QQ-L-201, Grade B
   a. Four (4) pound minimum for use at roof drains and soil stacks.

F. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.

B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.

C. Match finish of exposed heads with material being fastened.

D. Mechanical Fasteners:
1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
2. Washers: Steel washers with bonded rubber sealing gasket.
3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).

4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.

E. Clips:
1. Cleat (coping / fascia): Minimum 22 gauge or .050 aluminum, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.

B. Flux:
1. Phosphoric acid type, manufacturer's standard.
a. For Use with Steel or Copper: Rosin flux
b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.

C. Underlayment:
1. 40 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting: Grace Ice and Water Shield HT, Soprema HT underlayment, Carlisle WIP 300 HT underlayment or similar product.
2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.

D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.

E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.

F. Sealant:
1. Type A:
a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
2. Type B:
a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.

G. Termination Bar:
1. Material: Stainless steel or extruded aluminum bar with lipped profile.

2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
3. Approved Product / Manufacturer: “TB 125” manufactured by TruFast Corp., or approved equal.

H. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.

I. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.

J. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

2.5 FABRICATION

A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.

B. Comply with manufacturer's installation instructions and recommendations.

C. Shop fabricate Thru-wall, counterflashings, expansion joint metal and wind clips to greatest extent possible.

D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.

E. Face of any fabricated vertical metal fascia or coping shall not exceed 8” without stiffener band or birds beak. If stiffener band or birds beak cannot be fabricate, contractor to use multiple pieces of metal to achieve overall distance without going over the 8” maximum per piece.

F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.

G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.

H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.

I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.

J. Fold back edges on concealed side of exposed edge to form hem.

K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.

L. Seams:
1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.

N. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

A. Metal Flashings:
1. Through Wall Receiver Tray: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than ¾”.
2. Counterflashings: Minimum .040 prefinished aluminum, formed in maximum ten (10) foot lengths.

B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.

C. Roof Penetrations:
1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
2. Flashing Pans:
   a. 24 gauge stainless steel.
   b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
   c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
   d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.

D. Metal Edge / Fascia:

1. Edge Systems One “One Gravel Stop” for Modified Bitumen Roof Systems: Features a continuous cleat with pre-slotted fastening holes and staggered openings in 40% of the roof flange.
   1) Metal:
      a) .040 inch (1.01 mm) aluminum.

b) 24 gauge galvanized steel.

2) Finish:
   a) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
3) Fascia: Standard 12'-0" lengths with matching concealed joint splice plates.
4) Splice Plates and 22 gauge galvanized continuous cleats with slotted holes are included
5) Performance:
   a) 20 Year, 160 mph Wind Warranty.
   b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to a design pressure of 276 lbs./ft^2 to comply with the International Building Code.
   c) Factory Mutual approved I-285 for wind up lift protection.

E. Metal Coping

1. Perma-Tite Coping
   1) Construction:
      a) Metal:
         1) .040 inch (1.01 mm) aluminum.
         2) 24 gauge galvanized steel.
      b) Finish:
         1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of standard and premium colors.
   2) Coping Cap: Length of 12'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
   3) Coping Vertical Face and Back Leg: 2 ¼" to 12 ½" manufactured to job requirements.
   4) Concealed Splice Plates: 8" wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
   5) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
   6) Fasteners: 1 ½" stainless steel with driver.
   7) Performance:
      a) 20 Year, 160 mph Wind Warranty
      b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to comply with the International Building Code.
      c) Factory Mutual 1-90 approved for wind up lift protection.
      d) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".

F. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.

G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.

H. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.

I. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.

1. Minimum 0.040 inch thick prefinished aluminum formed in maximum twelve (12) foot lengths.
2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c.,1/8" Stainless Steel Pop Rivits, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
4. Supply Drip Edge at gutter.
5. For Modified Bitumen Systems: Include FlashThrough Drip Edge without Continuous Cleat.
6. 24 gauge galvanized steel with membrane manufacturer's coating (specify)
7. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
8. Install all anchoring devices as outlined in manufacturer literature.
9. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
10. Gutter Straps and Supports: Minimum 3 per 12'-0" length, .100 inch thick downspout straps: Strap type, like metal, match color.
11. Downspouts: Minimum 0.040 inch thick prefinished aluminum (match color).
12. Downspout straps: Strap type, like metal, match color.
13. Gutter Screen: .050" Aluminum with ¼" dia. perforations

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrates are smooth and clean to extent required to perform sheet metal work.

B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.

C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.

D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

A. Field measure site conditions prior to fabrication work.

B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
   1. Prefabricated corners;
   2. transitions;

3. changes in direction, elevation, and plane; and
4. at intersections.

B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.

C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
1. Ensure approved fasteners are used throughout the project.

2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips and cleats.

3. Ensure sufficient amount of waterblock is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**

D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.

E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.

F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
3. Coordinate installation of through-wall flashing with the masonry contractor.
4. Seal through-wall in conjunction with masonry wall waterproofing.
5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.

G. Sanitary Vent Stacks (As Required):
1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.

H. Gutters / Downspouts:
1. Install gutters prior to edge metal and otherwise as detailed.
2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer.
3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.

B. Remove scraps and debris and leave work area clean.

C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.

D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.

E. Paint metal flashings that have been soiled with bitumen with aluminized paint.

F. Clean other work damaged or soiled by Work of this Section.

G. Protect finished work from damage.

END OF SECTION

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Provide flexible flashing where shown on drawings or required.

1.3 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete
B. Section 04 20 00 – Unit Masonry
C. Section 07 27 26 – Fluid Applied Air Barrier System
D. Section 07 41 13 – Prefinished Metal Roofing
E. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
F. Section 09 21 16 – Gypsum Wallboard Systems (Exterior Sheathing)

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer’s specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer’s installation instructions.

B. Certification: Manufacturer’s affidavit that materials used in Project contain no asbestos.

C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

A. Flashing:
   1. Copper Laminated Flashing (Contractor’s Option – in lieu of asphalt-free copper fabric flashing):

a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
   1) Modified asphalt compound coated.
   2) Asphalt saturated, waterproof glass fiber laminated fabric.
b. Approved Manufacturers:
   1) Advanced Building Products, Inc.
   2) Hohmann & Barnard, Inc.
   3) Sandell Manufacturing Company, Inc.
   4) York Manufacturing, Inc.
c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings

2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of copper laminated flashing):
   a. Glass fabric scrim bonded to a full sheet of copper for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
   b. Approved Product / Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Fabric NA or Copper-Fabric SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
3. Asphalt-free Stainless Steel Flexible Flashing (Contractor's Option – in lieu of copper laminated or asphalt-free copper fabric flashing):
   a. Flexible minimum 2 mil thickness, Type 304 stainless steel sheet with factory applied adhesive with a release liner on one side for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
   b. Approved Product / Manufacturer: York 304 as manufactured by York Manufacturing, Inc.; or Mighty-Flash-SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
4. Membrane Flashing:
   a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by Manufacturer.
   b. Approved Products / Manufacturers:
      1) "CCW-705 TWF" manufactured by Carlisle Coatings and Waterproofing
      2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
      3) "Blueskin TWF" manufactured by Henry Co.
      4) "Air-Shield Through wall flashing" manufactured by W.R. Meadows, Inc.
      5) ""TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
      6) AquaFlash 500" manufactured by Fiberweb.
5. Substrate Primer: Provide as instructed by Membrane Manufacturer.
6. Termination Bar: 14 ga. minimum thick by 1" minimum wide stainless steel, with pre-punched holes and ¼" minimum shouldered top flange. Provide with self-tapping screws.
7. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw attach into wood blockings or substrate walls and strip into air barrier system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flashing:

1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
2. Application Guidelines - Install flashing at the following locations:
   a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.

   b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
4. Provide drip edge flashing at weep conditions with membrane flashing. Cut ¼" to ½" behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
8. Thru-Wall Flashing: Shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
9. Lintel: Premolded or field molded end dams must be provided at each end of all lintels.
10. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.

11. Heads, Jambs and Sills: Flashing for heads and sills shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
12. Windows: wrap all heads, sills and jambs into opening with flexible flashings.
13. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
14. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
15. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
16. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
17. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
18. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
19. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
20. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
21. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.
22. Lintels: Provide pre-molded end dams at all lintel ends.

B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back 3/4 inch from face of masonry.

3.2 APPLICATION

A. Protect membrane from overexposure to direct sunlight.

B. Follow manufacturer's recommendations for installation.

C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

END OF SECTION 07 65 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 INSTALLATION RESPONSIBILITY

A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.

B. Coordinate the Work specified herein with the following Work:
1. Roofing
2. Roofing sheet metal
3. Mechanical equipment
4. Plumbing
5. Electrical

1.3 REFERENCES

A. Federal Specifications (FS)
1. TT-S-00227E

B. National Roofing Contractors Association (NRCA)

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual

1.4 SUBMITTALS

A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

C. Contractor to provide proof of membrane material compatibility for roof bracing and supports.(Refer to section 2.6)

1.5 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

1.6 WARRANTY

A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:

1. Noticeable deterioration of finish
2. Water infiltration into the building or within the construction.

C. Rooftop supports – 5 year limited warranty.

D. Roof bracing – 20 year limited warranty included in roofing warranty.
1. Water infiltration into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

A. Frames:
1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
a. Minimum 18 gauge, and as engineered by manufacturer.
b. Minimum 18 gauge for curbs supporting HVAC units
c. Minimum 20 gauge for expansion joint curbs.
2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
3. Base Plates: Integral to frame and welded.
4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.

B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.

C. Curb Height: Minimum 8 inch above finished roof.
1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.

D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.

E. Counterflashing: 24 gauge stainless steel

F. Counterflashing Cap: Stainless steel.

G. Cants:
1. Non-canted curb style installs either under or on top of metal decks with insulation.
2. Cants shall be provided under Section 07 52 19 – Roofing

H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles

will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.

I. Approved Manufacturers:
1. Custom Curb, Inc.
2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Contractor built supports are not allowed)

A. Gas Pipe Supports:
1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10” x 16” x 3”; 5.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3” O.D. and smaller.
2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12” x 12” x 3”; 3 lbs. each or 18” x 18” x 3”; 7 lbs. each or 18” round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3” O.D.
3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

B. Electrical Conduit / Condensate Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10” x 16” x 3”; 5.5 lbs. each) and stainless steel channel, rods, washers and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3” O.D. and smaller.
2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12” x 12” x 3”; 3 lbs. each or 18” x 18” x 3”; 7 lbs. each or 18” round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3” O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

C. Chilled Water Pipe Supports:
1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18” x 18” x 3”; 7 lbs. each or 18” round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

D. Crossover / Steps Pipe Supports:
1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors and stainless steel channel, rods, washers and nuts; Basis of design, PHP Crossover.
2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.

E. Installation:

1. Provide pipe supports at no greater than 8'-0" o.c. or as otherwise indicated in Manufacturer's Shop Drawings.
2. Provide pipe supports spaced so deflection of piping does not exceed 1/240 of span. If deflection exceeds 1/240 of span, decrease support spacing to 6'-0" o.c.
3. Provide complete and adequate support of all piping, ducts and conduit.
4. Provide protective isolation pads adhered to the roof system below each pipe support using Roof System Manufacturer's approved adhesive.
5. Provide each pipe support adhered to the protective isolation pads using Roof System Manufacturer's approved adhesive.

2.4 ROOF TO ROOF EXPANSION JOINT

A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

2.5 ROOF PENETRATION HOUSING

A. Provide rain-proof our-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and water tight. To be used with our exclusive two-piece aluminum and / or stainless steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.

B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

2.6 ROOF DRAIN / DOWNSPOUT WALL NOZZLE

A. Downspout Wall Nozzle at Concealed Roof Drain Leader / Discharge: Josam 25010 Series cast bronze Downspout Nozzle with loose flange and inlet threaded connection or Architect approved equal. Diameter appropriate to downspout size.

2.7 PLUMBING PEDESTAL HYDRANT

A. Provide freeze-proof pedestal hose station / hydrant with stainless steel shroud, welded stainless steel flange, black powder coated cast aluminum dome handle, mail hose fitting and vacuum breaker. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.

B. As manufactured by MAPA Products Model MPH-24D:24/9 Pedestal Hydrant as required for condition or Architect approved equal.

2.8 ELECTRICAL PEDESTAL DISCONNECT / OUTLET

A. Provide rain-proof pedestal disconnect with stainless steel square tubing and welded stainless steel flange. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.

B. As manufactured by MAPA Products Model MPD-(XX) Pedestal Disconnect as required for condition or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.

B. Coordinate with roofing operation for watertight integrity.

C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION

SECTION 07 72 33 - ROOF SCUTTLE (HATCHES) AND HEAT/SMOKE VENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. Section 03 32 16- Lightweight Insulating Concrete Deck System

B. Section 05 31 00 - Metal Deck

C. Section 05 50 00 - Miscellaneous Metals

D. Section 06 10 00 - Rough Carpentry

E. Section 07 52 19 – Modified Bitumen Membrane Roofing System

1.3 SUBMITTALS

A. Product Data: Submit schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.

B. Shop Drawings: Include materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

1.4 WARRANTY

A. Warrant the work specified herein for five (5) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
1. Faulty, improper or inadequate attachment or installation.
2. Difficult or noisy operation.
3. Noticeable deterioration of finish.
4. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on products manufactured by The Bilco Company.

B. Manufacturers listed below whose products are equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Acudor Products Inc.
2. Babcock-Davis Hatchways, Inc.
3. Dur-Red Products

4. J. L. Industries, Inc.
5. Karp Associates, Inc.
6. Nystrom Building Products

2.2 ROOF SCUTTLES (HATCHES)

A. Size: 2 feet-6 inches x 3 feet-0 inches, unless shown otherwise.

B. Thermally Broken Cover: Shall be 11 gauge aluminum with 3" concealed polyisocyanurate insulation, 5" beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load., fully covered and protected by an aluminum liner.

C. Thermally Broken Curb: Shall be 12 inches in height and of 11 gauge aluminum. It shall be formed with a 5-1/2 inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiber board three (3) inches in thickness.

D. Thermally Broken Scuttle (Hatch): Shall be completely assembled with heavy pintle hinges, positive snap latch with turn handles, padlock hasps inside and outside, and a mechanically retained thermoplastic rubber gasket. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. Cover shall be equipped with an automatic hold-open arm complete with red vinyl grip handle to permit easy release and one-hand control of the cover to its closed and latched position. All hardware shall be stainless steel. Scuttle factory finish shall be mill finish aluminum.

E. Approved Model / Manufacturer: Type No. “S-50TB” Roof Scuttles (Hatches) for ladder access, or Architect approved equal.

F. Ladder: As specified in Section 05 50 00, Miscellaneous Metals. Ladder shall be oriented and mounted along the short dimension of the hatch.

G. Fall Protection Safety Rail: 30”x36” Model SP-3036 Made by **SafePro L.C.**

2.3 HEAT AND SMOKE VENTS

A. Size: 4 feet-0 inches x 8 feet-0 inches unless shown otherwise.

B. Covers: Shall be 11 gauge aluminum with three (3) inch beaded flange and formed reinforcing members welded to support a minimum live load of 40 lb / sq.ft. Insulation shall be of glass fiber, one (1) inch in thickness, fully covered and protected by a 18 gauge aluminum cover liner. No water standing on top of the cover will be permitted.

C. Curb: Shall be of 11 gauge aluminum, 12 inches in height on hinge sides with a five (5) degree pitch to the fixed center channel. Curb shall be formed with a 3-1/2 inch flange with holes for securing to the roof deck and with an integral metal capflashing of the same gauge and material as the curb, full welded for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiberboard three (3) inches in thickness. All hardware shall be zinc plated and chromate sealed. Factory finish shall be mill finish aluminum.

D. Vent: Shall be completely assembled with a Thermolatch(R) positive hold/release mechanism designed to hold the covers in the closed position against 90 lb/sq.ft.) wind uplift forces without overstressing the fusible link. Each cover shall have a minimum of three (3) heavy pintle hinges, a mechanically retained thermoplastic rubber gasket, heavy duty shock absorbers and pull handles for inside and outside operation. Vent shall open automatically when heat breaks the 165 degrees F fusible link and shall be labeled as being FM Approved or UL Listed.

E. Approved Model / Manufacturer: Fire Vent Type DSH4896 Double Leaf Fire Vents or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Roof hatches and heat / smoke vents shall be welded to structural steel frame of building.

B. Install hatches and heat / smoke vents in accordance with details on drawings, approved shop drawings, and manufacturer's instructions.

END OF SECTION

SECTION 07 81 00 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Sprayed fire resistive materials.
   2. Accessories necessary for a complete installation.

1.3 RELATED DOCUMENTS

A. Section 07 21 00 – “Thermal Insulation.”

1.4 DEFINITIONS

A. SFRM: Sprayed fire resistive materials.

1.5 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Steel members shall be considered to be unrestrained unless specifically noted otherwise.
   2. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor are not allowed.

C. Asbestos: Provide products containing no detectable asbestos.

D. Dry mix inorganic spray-applied fire resistive material containing mineral slag wool and Portland-cement are not permitted.

1.6 SUBMITTALS

A. Product Data: Technical data, installation instructions, and UL listing for each type of product.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
   1. Extent of fireproofing for each construction and fire resistance rating.
   2. Applicable fire resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   3. Minimum fireproofing thickness necessary to achieve required fire resistance rating of each structural component and assembly.
   4. Treatment of fireproofing after application.

C. Samples: Submit for each exposed product and for each color and texture specified, 4 inches (102 mm) square in size.

D. Product Certificates and Reports:
1. Certificates: Submit manufacturer's precut certificates for each type of SFRM.
2. Evaluation Reports: Submit ICC-ES evaluation report.
3. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating:
   a. Materials have been tested for bond with substrates.
   b. Materials have been verified by SFRM manufacturer to be compatible with substrate and coatings.
   c. Interpretation of test results and written recommendations for substrate preparation needed for adhesion.
4. Preconstruction test reports.
5. Field quality control reports.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Building Code: Comply with applicable provisions of the IBC for fire protection.
2. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame Spread Index: 10 or less.
   b. Smoke Developed Index: 10 or less.

B. Installer Qualifications: A firm or individual having minimum 5 years documented experience who is certified or licensed and qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

C. Source Limitations: Obtain fireproofing for each fire resistance design from single source.

D. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified.
3. Verify that manufacturer, through its own laboratory testing or field experience, attests that coatings are compatible with fireproofing.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures.

E. Preinstallation Conference: Conduct conference at site.
1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life, and fire resistance ratings applicable to Project.

B. Use materials with limited shelf life within period indicated. Remove from site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from site and discard wet or deteriorated materials.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 degrees F (7 degrees C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

1.10 COORDINATION

A. Sequence and coordinate application of sprayed fireproofing with related work to comply with requirements:
1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
2. Provide temporary enclosures for applications to prevent deterioration of fire resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire resistive material to abrasion and damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire resistive material to metal deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire resistive material.
5. Do not apply fire resistive material to metal floor deck substrates until concrete topping has been completed.
6. Do not begin applying fire resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.11 WARRANTY

A. Written warranty signed by installer, and Contractor in which manufacturer agree to repair or replace fireproofing materials that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire response testing, and other causes not reasonably foreseeable under conditions of normal use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design: Islolatek International. Other manufacturers are subject to compliance with requirements.
   1. Grace Construction Products.
   2. Carboline Company; a subsidiary of RPM International.
   3. Southwest Fireproofing Products Co.

B. Sprayed Fire Resistive Material: Factory mixed, lightweight, dry formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.
   1. Application: Interior locations not exposed to damage or moisture.
   2. Bond Strength: Minimum 150 lbf/sq. ft. (7.18 kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
   3. Density: Not less than density specified in the approved fire resistance design, according to ASTM E 605.
   4. Thickness: As necessary required for fire resistance design indicated, measured according to requirements of fire resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
   5. Compressive Strength: Minimum 1,400 psf (68.9 kPa) according to ASTM E 761.
   6. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
   7. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
   8. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
   9. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
   10. Fungal Resistance: Treat products with antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.
   11. Finish: Spray textured finish unless otherwise indicated.
   12. Basis of Design: CAFCO 300 Series as manufactured by Islolatek or comparable product.

C. Sprayed Fire Resistive Material: Factory mixed, lightweight, wet formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.
   1. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Bond Strength: Minimum 1000-lbf/sq. ft. (47.88-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
   3. Density: Not less than 40 lb/cu. ft. (640 kg/cu. m) as specified in the approved fire-resistance design, according to ASTM E 605.
   4. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design
   5. Combustion Characteristics: When tested in accordance with ASTM E 136 shall be noncombustible
   6. Surface-Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
      a) Flame Spread Index: 0.
      b) Smoke Developed: 0.

   7. Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than 10 percent when subjected to a crushing force of 43,200 psf (2068 kPa).

8. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
9. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
10. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
11. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
12. Fungal Resistance: When tested in accordance with ASTM G21, the material shall show resistance to mold growth for a minimum period of 28 days with or without the use of a mold inhibitor.
13. Finish: Spray textured finish unless otherwise indicated.
14. Basis of Design: Isolatek Fendolite M-II or comparable product.

D. Auxiliary Materials: Provide auxiliary materials compatible with fireproofing and substrates and approved by UL for use in fire resistance designs indicated.
1. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL *Fire Resistance Directory*.
2. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire resistance designs indicated and fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
3. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire resistance designs indicated; approved and provided by fireproofing manufacturer.
4. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for substrates and conditions affecting performance of the work and according to each fire resistance design.
1. Verify substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
4. Verify concrete work on steel deck is complete before beginning fireproofing work.
5. Verify roof construction, installation of rooftop HVAC equipment, and related work are complete before beginning fireproofing work.
6. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
7. Prepare written report listing conditions detrimental to performance of the work.
8. Proceed with installation after correcting unsatisfactory conditions.

B. Conduct tests according to fireproofing manufacturer's written recommendations to verify substrates are free of substances capable of interfering with bond.

C. Prepare written report listing conditions detrimental to performance of the work.

D. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Cover adjacent work subject to damage from fallout or overspray of fireproofing materials during application. Clean substrates of substances that could impair bond of fireproofing.

B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless in satisfactory condition to receive fireproofing.

C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:
1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
1. For applications over encapsulant materials, including lockdown (post removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
2. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
   1. Cure fireproofing according to fireproofing manufacturer's written instructions.

I. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

J. Cure fireproofing according to fireproofing manufacturer's written instructions.

K. Finishes: Where indicated, apply fireproofing to produce the following finishes:

   1. Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
   2. Spray Textured Finish: Finish left as spray applied with no further treatment.
   3. Rolled, Spray Textured Finish: Even finish produced by rolling spray applied finish with a damp paint roller to remove drippings and excessive roughness.
   4. Skip Troweled Finish: Even leveled surface produced by troweling spray applied finish to smooth out the texture and neaten edges.
   5. Skip Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Test and inspect as required by the applicable building code.

B. Perform the tests and inspections of completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.
   1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
   2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel applied product.

END OF SECTION 07 81 00

SECTION 07 84 00 - FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Fire resistive joint systems.
   2. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Penetration Fire Resistance Systems:
   1. For penetrations through vertical and horizontal fire resistance rated constructions, including both empty openings and openings containing penetrating items, provide firestop systems produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of construction penetrated.
   2. Rated Systems: Provide penetration firestop systems with ratings determined in accordance with UL 1479 for C-AJ, C-BJ, C-BK, F-A, F-B, F-C, W-J, W-K, and W-L classified systems.
      a. F Rated Systems: Provide penetration firestop systems with F ratings indicated, but not less than that equaling or exceeding fire resistance rating of constructions penetrated.
      b. T Rated Systems: For specified conditions, provide penetration firestop systems with T ratings indicated, as well as F ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas.
      c. L Rated Systems: Where penetration firestop systems are indicated in smoke barriers, provide penetration firestop systems with L ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 degrees F (204 degrees C).
      d. For penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to conditions both during and after construction.
      e. For piping penetrations for plumbing and wet pipe sprinkler systems, provide moisture resistant penetration firestop systems.
      f. For penetrations involving insulated piping, provide penetration firestop systems not requiring removal of insulation.

   3. For penetration firestop systems exposed to view, provide products with flame spread and smoke developed indexes of less than 25 and 450, respectively, determined in accordance with ASTM E 84.

B. Fire Resistive Joint Systems: System produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of assembly in which fire resistive joint systems are installed.
   1. Joint Systems in and between Fire Resistance Rated Constructions: Provide systems with assembly ratings equaling or exceeding fire resistance ratings of construction that are join, with movement capabilities and L ratings] indicated determined by UL 2079.

2. Perimeter Fire Resistive Joint Systems: For joints between edges of fire resistance rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated determined by NFPA 285 and UL 2079.
3. For fire resistive systems exposed to view, provide products with flame spread and smoke developed indexes of less than 25 and 450, respectively determined in accordance with ASTM E 84.

1.4 SUBMITTALS

A. Product Data: Technical data including installation recommendations, construction conditions, applicable UL assemblies.

B. Shop Drawings: For each penetration firestop or fire resistive joint system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetration. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from qualified testing and inspecting agency, applicable to each firestop system configuration for construction and penetrating items.

C. Product Certificates: For penetration firestop system products, signed by product manufacturer.

D. Product Test Reports: From a qualified testing agency indicating penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements of the IBC and the fire code.
2. Fire Test Response Characteristics: Provide firestop systems complying with requirements:
   a. Penetration Firestopping: Penetration firestop systems are identical to those tested in accordance with UL. Provide rated systems complying with requirements.
      1) Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
      2) Penetration firestop system products bear classification marking of qualified testing and inspecting agency.
      3) Penetration firestop systems correspond to those indicated by reference to penetration firestop system designations listed by UL in its *Fire Resistance Directory* and FM Global in its *Building Materials Approval Guide*.

   b. Fire Resistive Joints: Perform fire resistance tests by UL with follow up inspection services for fire resistive joint systems acceptable to authorities having jurisdiction.
      1) Fire resistive joint system products bear classification marking of qualified testing and inspecting agency.
      2) Fire resistive joint systems correspond to those indicated by reference to penetration firestop system designations listed by UL in its *Fire Resistance Directory*.

B. Installer Qualifications: A firm experienced in installing firestop systems and who has been approved by FM Global according to FM Global 4991 *Approval of Firestop Contractors* or been evaluated by UL and found to comply with UL *Qualified Firestop Contractor Program Requirements* and has minimum 5 years documented experience in installing firestopping assemblies
1. Manufacturer's willingness to sell its penetration firestop system products to Contractor or to Installer engaged by Contractor does not qualify buyer/installer.

C. Installation Responsibility: Assign installation of penetration firestop systems and fire resistive joint systems to a single qualified installer.

D. Source Limitations: Obtain firestop systems, for each kind of penetration and construction condition indicated, one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestop system products to site in original, unopened containers or packages with intact and legible manufacturer labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install firestop systems when ambient or substrate temperatures are outside limits permitted by firestop system manufacturer or when substrates are wet due to rain, frost, condensation, or causes.

B. Install and cure fire resistive joint systems in accordance with manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced air circulation.

C. Ventilate firestop systems per manufacturer's written instructions by natural means or, where inadequate, forced air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that firestop resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core drilled holes, or cut openings to accommodate penetration firestop systems.

C. Joint System: Coordinate sizing of joints to accommodate fire resistive joint systems.

D. Do not cover up penetration firestop system or fire resistive joint system installations that will become concealed behind other construction until building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturer: Subject to compliance with requirements, provide firestop systems by one of the following for each application required:
1. Hilti, Inc.
2. Nelson Firestop Products.
3. RectorSeal Corporation (The).
4. Specified Technologies Inc.
5. 3M; Fire Protection Products Division.
6. USG Corporation.
7. Tremco Commercial Sealants and Waterproofing.

B. Compatibility: Provide firestop systems compatible with each other; with substrates forming openings; and with items penetrating penetration firestop systems, under conditions of service and application, demonstrated by penetration firestop system manufacturer based on testing and field experience.

C. Accessories: Provide components for each firestop system necessary to install fill materials. Use components specified by penetration firestop or fire resistive joint system manufacturer and UL. Accessories include, but are not limited to:
1. Penetration Firestop Systems: Provide penetration firestopping produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and gases, and maintain original fire resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with substrates forming openings, and with penetrating items if any.
2. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   a. Permanent forming/damming/backing materials, including the following:
      1) Slag wool fiber or rock wool fiber insulation.
      2) Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      3) Fire rated form board.
      4) Fillers for sealants.

   b. Temporary forming materials.
   c. Substrate primers.
   d. Collars.
   e. Steel sleeves.

D. Fire Resistive Joint Systems: Sealants complying with UL 1479 including F, T, and L ratings.

E. Duct Wrap for Ducts: Materials listed in the UL Fire Resistance Directory under File R8418, Category CAJ7009, File R14229 Categories CAJ 7013, CAJ 7015, CAJ 7020, CAJ 7022, YYET, and Grease Duct Enclosures and having minimum 2 hour fire resistive rating for grease or air duct enclosure materials.

F. Composition Edge Banding: Materials listed in UL Fire Resistance Directory UL 10c standard.

2.2 FIRE STOPPING SYSTEMS

A. Joint Resistive Systems:
1. Joints in Smoke Barriers: Provide fire resistive joint systems with ratings determined per UL 2079.
   a. L Rating: Not exceeding 5.0 cfm/ft (0.00775 cu. m/s x m) of joint at 0.30 inch wg (74.7 Pa) at both ambient and elevated temperatures.

2. Exposed Fire Resistive Joint Systems: Provide products with flame-spread and smoke developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
3. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

2.3 MIXING

A. For products requiring mixing before application, comply with penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and items or

procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and conditions affecting performance of work. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestop systems complying with firestop system manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestop systems. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended in writing by penetration firestop system manufacturer complying with manufacturer's recommended. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of work and that would be permanently stained or damaged by contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 INSTALLATION

A. Fire Resistive Joint System: Install fire resistive joint systems to comply requirements and manufacturer's written installation instructions for products and applications indicated.
   1. Install forming/packing/backing materials and accessories of types required to support fill materials during application and in position needed to produce cross sectional shapes and depths required to achieve fire ratings indicated.
   2. Install fill materials for joint systems by proven techniques to produce the following results:
      a. Fill voids and cavities formed by openings and forming/packing/backing materials required to achieve fire resistance ratings indicated.
      b. Apply fill materials to contact and adhere to substrates formed by joints.
      c. For fill materials remaining exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so labels are visible at removal.
   1. Use mechanical fasteners for metal labels. For plastic labels, use self adhering type with adhesives capable of permanently bonding labels to surfaces and, in combination with

label material, resulting in partial destruction of label if removal is attempted. Include information on labels:

a. The words *Warning - Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage*.
b. Contractor's name, address, and phone number.
c. Firestop system designation of applicable testing and inspecting agency.
d. Date of installation.
e. Penetration firestop system manufacturer's name.
f. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire resistive joint systems are damaged or removed due to testing, repair or replace fire resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire resistive joint systems with construction after inspection reports are issued and installations comply with requirements.

3.6 CUTTING AND PATCHING

A. Cut, patch, and repair firestopping to accommodate work. Repair cracks and indented surfaces. Repair surfaces around items built into or penetrate surfaces. Repair and replace work to eliminate blister, buckles, dry outs, and similar imperfections. Repair and replace work required to comply fire resistance ratings.

B. After completion of work in and around the areas of firestopping, repair and replace damaged firestopping.

3.7 CLEANING AND PROTECTION

A. Clean excess fill materials adjacent to openings as work progresses by methods and with cleaning materials approved in writing by penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation ensuring penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestop systems immediately and install new materials to produce systems complying with requirements.

END OF SECTION 07 84 00

SECTION 07 91 00 - EXTERIOR WALL JOINT SEALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Preformed, precompressed, expanding foam joint seals for expansion joints in exterior walls.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 07 92 00 - Joint Sealers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
1. Convene at Project site 2 weeks prior to beginning work of this Section.
2. Attendance: Architect,Contractor,Construction Manager, joint seal installer, and related trades
3. Review and discuss:
a. Joint seal manufacturer’s requirements, project conditions, allowable structural movement at joints, and protection of completed work.
b. Transitions in plane and direction, and requirement for continuity of seal through watertight transitions from wall expansion joint to other interfacing expansion joint systems at adjacent construction.

1.3 SUBMITTALS

A. Action Submittals:
1. Shop Drawings:
a. Indicate joint locations, dimensions, and adjacent construction.
b. Provide details for transitions in plane and direction for continuity of seal through watertight transitions from wall expansion joint to other interfacing expansion joint systems at adjacent construction.
2. Product Data: Material description and application instructions.
3. Samples:
a. Minimum 2 x 2 inch joint seal samples showing available colors.
b. Minimum 6 inch long samples of each joint seal

B. Informational Submittals:
1. Manufacturer’s certification that:
a. Products are capable of withstanding temperature of 150 degrees F (65 degrees C) for 3 hours while compressed to minimum of movement capability dimension without evidence of bleeding of impregnation medium from material.
b. Same material after heat stability test and after cooling to room temperature will self-expand to maximum of movement capability dimension within 24 hours at 68 degrees F (20 degrees C).

C. Sustainable Design Submittals: Refer to Division 01.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Minimum 10 years experience in production of specified materials.

B. Installer Qualifications: Minimum 2 years experience in work of this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. In accordance with manufacturer's instructions.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

A. Environmental Product Declarations (EPDs)
1. Provide products with a current, third-party verified Environmental Product Declaration (EPD) in accordance with:
a. ISO 14025
b. ISO 21930:2017

2. EPDs shall:
a. Be product-specific with clear applicability to the submitted system
b. Be externally verified by an approved program operator
c. Report environmental impacts, including Global Warming Potential (GWP)

3. Submit EPD documentation as part of the submittal package.

B. Embodied Carbon Reporting
1. Provide expansion joint systems with documented embodied carbon values as reported in the product's EPD.

2. Reporting Requirements:
a. Report Global Warming Potential (GWP) for life cycle stages A1-A3 (minimum)
b. Include A4–A5 and end-of-life stages C1–C4
c. Express results in kg CO_2 per functional unit (e.g., per linear foot or meter of joint system)

C. Material Optimization (Optional – Include if pursuing LEED or similar)
1. Provide products that contribute to sustainable material credits under LEED or equivalent programs.

2. Documentation may include:
a. Environmental Product Declarations (EPDs) for disclosure credits
b. Product ingredient disclosures, if applicable

D. Submittals
1. Submit the following:
a. Environmental Product Declaration (EPD)
b. Embodied carbon data summary (GWP values)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on products by Sika Emseal, 800-526-8365, www.emseal.com.

B. Substitutions: Refer to Division 01.

2.2 MATERIALS

A. Exterior Wall Joint Seal:
   1. Basis of Design: Seismic Colorseal by Sika Emseal.
   2. Description: Silicone coated, ultraviolet resistant, watertight, primary wall seal with factory-applied adhesive on one side.
   3. Form: Precompressed to less than nominal material size for installation into designed joint size equal to material nominal size.
   4. Movement capability: Plus and minus 50% (total 100%) of nominal material size.
   5. R-value: 2.15 per inch depth at nominal joint size compression, tested to ASTM C518.
   6. STC rating: 52 in STC 56 wall, tested to ASTM E90.
   7. OITC rating: 38 in OITC 38 wall, tested to ASTM E90.
   8. Air permeability: Maximum 0.02 liter per second per square meter, tested to ASTM E283 at 75 Pa.
   9. Water penetration: No water penetration, tested to ASTM E331 at 5000 Pa test pressure.
   10. Wind loading:
      a. 0.1 mm net deflection, tested to ASTM E330 at 2730 Pa or 150 MPH wind.
      b. 0.6 mm net deflection, tested to ASTM E330 at 4854 Pa or 200 MPH wind.
   11. Weathering: Sealing of outside wall joints per DIN 18542-1999 / G155-2013: Pass
   12. VOC Emissions: CDPH-1.2-2017: Pass
   13. Color: To be selected from Sika Emseal full color range.
   14. Silicone: Field applied corner bead at face of seal to substrate interface, furnished by joint seal manufacturer, in same material and color as used in factory coating.
      a. Abrasion Resistance: Less than 1% weight loss, tested to ASTM D4060
      b. Fuel Resistance: Pass, tested to ASTM C719/C1135

PART 3 EXECUTION

3.1 PREPARATION

A. Clean joints thoroughly; remove loose and foreign matter that could impair adhesion or performance.

3.2 INSTALLATION

A. Install joint seal in accordance with Sika Emseal instructions and approved Shop Drawings.

B. Remove joint seal from precompressed packaging, immediately insert into joint, and allow to expand.

C. Use temporary retainers if required to maintain joint seals in position until expansion is complete.

3.3 JOINT SEALS SCHEDULE

A. Exterior Wall Joint Seals at Seismic Colorseal by Sika Emseal.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior sealants and sealants for moving joints, except for joints in those systems listed under Related Work.

B. Interior sealants and caulking.

1.2 RELATED WORK

A. Section 04 20 00 - Unit Masonry: Masonry control and expansion joints.

B. Division 7 - Roofing Sections: Sealants used in conjunction with roofing.

C. Section 07 84 00 - Firestopping: Firestopping penetrations.

D. Section 07 62 00 - Sheet Metal Flashing, Gutters, Downspouts and Trim: Sealants used in conjunction with sheet metal items.

E. Section 08 80 00 - Glazing Systems: Glazing sealants.

F. Section 09 21 16 - Gypsum Board assemblies: Acoustical sealants.

G. Division 23 - Mechanical Sections.

H. Section 32 13 13 - Concrete Paving: Site concrete paving expansion joint sealant.

1.3 REFERENCES

A. ASTM International (ASTM)
   1. C717, Standard Terminology of Building seals and Sealants
   2. C793, Standard Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants
   3. C794, Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
   4. C834, Standard Specification for Latex Sealants
   5. C920, Standard Specification for Elastomeric Joint Sealants
   6. C1193, Standard Guide for Use of Joint Sealants

B. Sealant, Waterproofing and Restoration Institute (SWRI)
   1. The Processional’s Guide

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Sample: On site sample for Architect's approval of colors.

C. Certification: Manufacturer’s affidavit that materials used in Project contain no asbestos.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Experienced in building sealant installation whose work has resulted in sealant installations with a record of successful performance.

B. Source Limitations: Unless specifically indicated, obtain each type of building sealant through one source from a single manufacturer.

C. Pre-construction Field Adhesive Testing: Prior to installation of building sealants, field test their adhesion to joint substrates in accordance with manufacturer’s instructions. Perform test in locations indicated by Architect. Perform test for each type of building sealant and each substrate as required by Architect. If required by Architect, arrange for tests to be performed with sealant manufacturer’s representative present. Follow-up review by Architect and manufacturer may be required to observe sealant performance over time and may result in re-application of sealant or replacement.

D. Cleaning: Facade sealants that have collected dirt at the time of Substantial Completion shall be cleaned over the entire facade prior to acceptance by the Owner. 11 months after final completion of the building, if the sealant joints show dirt, they shall again be cleaned over the entire façade.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of sealants when joint substrates are wet or when ambient temperature conditions are above limits permitted by sealant manufacturers or are below 40 degree F.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of sealants until contaminates which may interfere with adhesion are removed from substrates.

1.7 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination.

B. In addition, refer to information above concerning Field Adhesive Testing.

1.8 WARRANTY

A. Warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to:
1. Leaking
2. Cracking, splitting or releasing from substrate
3. Deterioration or color change

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Specifications are based on the products or materials of the named manufacturer, otherwise selection may be made from any manufacturer listed below whose products meet or exceed the specifications. Other manufacturers must have a minimum of five (5) years' experience manufacturing the products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

1. Typical Sealants:
   a. BASF
   b. Bostik
   c. Pecora, Inc.
   d. Sika
   e. Tremco Incorporated
2. Silicone Sealants at Appliances:
   a. Pecora, Inc.
   b. General Electric Co.
   c. Dow Corning

2.2 MATERIALS

A. Caulking for Exposed Non-Working Interior Locations:
   1. Type: Acrylic Latex, conforming to ASTM C834; single component, paintable.
   2. Applications: Use for interior wall and ceiling joints, joints between door and window frames and wall surfaces, and other interior non-traffic-bearing joints for which no other type of sealant is indicated.

B. Sealant for Working Joints and Exposed Vertical Exterior Locations:
   1. Type: Polyurethane, conforming to ASTM C920, Type S or M, Grade NS, Class 35; single or multi-component, non-sagging.
   2. Applications: Use for:
      a. Control, expansion, and soft joint masonry. Refer to drawings and Section 04 20 00, Unit Masonry for specific locations. Provide full sealant joints at building expansion joints.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. Other exterior non-traffic-bearing joints for which no other type of sealant is indicated.

C. Sealant for Exposed Exterior Traffic-bearing Locations:
   1. As specified in section 32 13 13, Concrete Paving

D. Acoustical Sealant:
   1. As specified in section 09 21 16, Gypsum Board Assemblies

E. Rubber Sealant:
   1. Type: Butyl sealant, conforming to ASTM C920, Type NT, Grade NS, Class 12-1/2; single component, solvent release, non-skinning, non-sagging.
   2. Movement Capability: Plus and minus 12-1/2 percent.
   3. Service Temperature range: -13 to 180 degree F.

F. Sealant at Sanitary Locations:

1. Type: Single component, silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 25, mildew resistant, non-yellowing.
2. Application: Use for joints between plumbing fixtures and floor and wall surfaces, and joints between kitchen and bathroom counter tops and wall surfaces, unless indicated otherwise. Use at all Kitchen appliances.
3. See Section 09 30 13, Ceramic Tile for sealant at tile surfaces.
4. Approved Product / Manufacturer: Sanitary SCS1700 Sealant manufactured by General Electric Company, Pecora Corp., Dow Corning, or Architect approved equal.

G. Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 50, use NT.
1. Use: Precast Concrete Joints between metals, glass, and plastics (Single component sealants).
2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates.
3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
4. Product and Manufacturer:
   a. BASF Building Systems; Omniseal 50.
   b. Dow Corning Corporation; 756 SMS, 791, 795, 995 as applicable.
   c. GE Advanced Materials, Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 as applicable.
   d. Sika Corporation, Construction Products Division; SikaSil-C995.

H. Primers, Cleaners, Top Coats: Use only materials listed as suitable in resistance to staining, compatibility and durability before proceeding.

I. Expanded Polyethylene Joint Filler: Provide flexible, compressible, closed-cell, polyethylene of not less than 10 psi compression deflection (25 percent); except provide higher compression deflection strength as may be necessary to withstand installation forces and provide proper support for sealants, surface water absorption of not more than 0.1 pounds per square foot, as manufactured by Sonneborn, or pre-approved equal.

J. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type, which will not be deteriorated by sealant application temperature as indicated.

K. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.1 APPLICATION

A. Temperatures: Do not install sealants when air temperature is under 40 degrees F. Sealants may be warmed to ease installation when recommended by the manufacturer.

B. Tooling: Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer. The tooling procedure shall press sealant against the sides of the groove. No materials shall be left "feathered" out or smeared on the abutting materials. If necessary, protect adjacent surfaces with tape. Completed joints shall have a uniform professional appearance. Use an anti-tack compound on sealant that does not set up fast enough to avoid dust collection.

C. Sealant Back-Up: Provide back-up filler where groove depth is too great to fill with sealant. Review joint design with Architect.

D. Compressive Filler: Seal vertical expansion joints with fillers. Provide compressible filler twice the width of the joint and with a depth of 1-1/2 times the compressed width. Lap ends 2 inch minimum.

E. Seal ends together in such a manner to allow natural drainage. Install filler by compressing material and sliding into joint. Align filler on one face of the joint before it expands to the full joint width.

END OF SECTION

07 95 00 - Watertight Roof Expansion Joint System

PART 1 – GENERAL

1.01 Work Included

A. The work shall consist of furnishing and installing waterproof expansion joints in accordance with the details shown on the plans and the requirements of the specifications. Expansion joints shall be a dual-seal, double-flanged, extruded thermoplastic rubber for sealing expansion joints in roofs through positive integration with the roofing membrane and a purpose-designed system for transitioning between the joint in the roof and joints in walls.

B. Related Work
- Division 3 - Cast-in-Place Concrete
- Division 7 - Thermal & Moisture Protection
- Division 7 - Sealants, Caulking and Waterproofing

1.02 Submittals

A. General – Submit the following according to Division 1 Specification Section.

B. Standard Submittal Package – Submit typical expansion joint drawing(s) indicating pertinent dimensions, general construction, expansion joint opening dimensions and product information.

C. Sample of material to be used in work is required at time of submittal.

1.03 Product Delivery, Storage and Handling

A. Deliver products to site in Manufacturer's original, intact, labeled containers. Handle and protect as necessary to prevent damage or deterioration during shipment, handling and storage. Store in accordance with manufacturer's installation instructions.

1.04 Basis of Design

A. All joints shall be designed to meet the specified performance criteria of the project as manufactured by: (USA & International) EMSEAL JOINT SYSTEMS, LTD 25 Bridle Lane, Westborough, MA 01581-2603, Toll Free: 800-526-8365. (Canada) EMSEAL, LLC 111 Royal Group Crescent, Woodbridge, Ontario, L4H 1X9, Canada Toll Free: 800-526-8365. www.emseal.com

B. Alternate manufacturers must demonstrate that their products meet or exceed the design criteria. Submittal of alternates must be made three weeks prior to bid opening to allow proper evaluation time.

1.05 Quality Assurance

A. The General Contractor will conduct a pre-construction meeting with all parties and trades involved in the treatment of work at and around expansion joints including, but not limited to, concrete, mechanical, electrical, HVAC, landscaping, masonry, curtain wall, waterproofing, fire-stopping, caulking, flooring and other finish trade subcontractors. All superintendents and foremen with responsibility for oversight and setting of the joint gap

must attend this meeting. The General Contractor is responsible to coordinate and schedule all trades and ensure that all subcontractors understand their responsibilities in relation to expansion joints and that their work cannot impede anticipated structural movement at the expansion joints, or compromise the achievement of watertightness or life safety at expansion joints in any way.

B. Warranty – Manufacturer's standard warranty shall apply.

1.06 SUSTAINABLE DESIGN REQUIREMENTS

A. Environmental Product Declarations (EPDs)
1. Provide products with a current, third-party verified Environmental Product Declaration (EPD) in accordance with:
a. ISO 14025
b. ISO 21930:2017

2. EPDs shall:
a. Be product-specific with clear applicability to the submitted system
b. Be externally verified by an approved program operator
c. Report environmental impacts, including Global Warming Potential (GWP)

3. Submit EPD documentation as part of the submittal package.

B. Embodied Carbon Reporting
1. Provide expansion joint systems with documented embodied carbon values as reported in the product's EPD.

2. Reporting Requirements:
a. Report Global Warming Potential (GWP) for life cycle stages A1–A3 (minimum)
b. Include A4–A5 and end-of-life stages C1-C4
c. Express results in kg CO_2 per functional unit (e.g., per linear foot or meter of joint system)

C. Material Optimization (Optional – Include if pursuing LEED or similar)
1. Provide products that contribute to sustainable material credits under LEED or equivalent programs.

2. Documentation may include:
a. Environmental Product Declarations (EPDs) for disclosure credits
b. Product ingredient disclosures, if applicable

D. Submittals
1. Submit the following:
a. Environmental Product Declaration (EPD)
b. Embodied carbon data summary (GWP values)

PART 2 – PRODUCT

2.01 General

A. Provide watertight, expansion joint by Sika Emseal for expansion joints in roof decks and isolation joints in non-traffic, high-movement and seismic structural joint in roof decks. Typical locations include, but are not limited to the following: applications for joints over occupied space, joints across roof lines, and solid slab construction anywhere waterproofed construction is specified. System shall perform waterproofing and movement-accommodation functions as the result of a single installation and without the addition of gutters, vapor barriers, bladders, or other devices suspended beneath or within the system in any way.

B. Provide RoofJoint as manufactured by Sika Emseal and as indicated on drawings for horizontal expansion joint locations.

C. System shall be comprised of: 1.) a heat weldable, Nitrile PVC extrusion with dual-level flange and, 2.) manufacturer supplied termination bar and anchors and, 3.) factory welded downturn transition in the RoofJoint gland that is sealed at a ship lapped 45-degree angle to mate with an interlocking factory-fabricated RoofJoint/SEISMIC COLORSEAL transition piece.

D. Final selection of the extrusion size to be coordinated between manufacturer, designer, and contractor(s) in consideration of expected movements as a product of structural design and expected temperature variations, taking into account as-built joint-gap sizes and temperatures at expected installation time. Width of joint-gaps at time of casting or cutting to be adjusted, if necessary, from baseline temperature used and specified by designer in determining system suitability.

E. Manufacturer's Checklist must be completed by expansion joint subcontractor and returned to manufacturer at time of ordering material.

2.02 Fabrication

A. Include details and manufacturing drawings indicating profiles of each type of expansion joint cover assembly, splice joints between sections, joinery with other types, special end conditions, fasteners, and relationship to adjoining work and finishes with specific reference to tie-in with deck waterproofing system through integration with expansion joint system dual-level flange.

B. Directional changes and terminations into vertical plane surfaces (walls, parapets, ends of decks, etc) as well as to transition the material through curbs or other in-slab plane changes to be provided by factory-manufactured assemblies that preserve continuity of seal. Transitions between RoofJoint and any other of Manufacturer's joint systems in the vertical plane to be executed according to Manufacturer's details and to be warranted as watertight.

PART 3 – EXECUTION

3.01 Installation

A. Preparation of the Work Area

1. The contractor shall provide properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer's standard system drawings or as shown on the contract drawings. Deviations from these dimensions will not be allowed without the written consent of the engineer of record.

2. The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Refer to Manufacturers Installation Guide for detailed step-by-step instructions.

3. System to be installed by qualified sub-contractors only according to detailed published installation procedures and/or in accordance with job-specific installation instructions of manufacturer's field technician. The applicator must be the same contractor as will be installing the deck waterproofing system. Bids must include for presence of paid-for manufacturer's field technician to be present during initial preparation, inspection, and material installation.

3.02 Clean and Protect

A. Protect the system and its components during construction. Subsequent damage to the expansion joint system will be repaired at the general contractor's expense. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish.

END OF SECTION

SECTION 08 11 13 HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCULENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide items shown on the Drawings and specified, including, but not limited to the following:
   1. Standard and fire rated steel doors.
   2. Steel frames for doors, sidelites, transoms, and windows.
   3. Louvers and vision lites in steel doors, if shown or required.
   4. Thermally rated steel doors.

B. Related Sections:
   1. Section 05 40 00: Cold-Formed Metal Framing.
   2. Section 07 92 00: Joint Sealants.
   3. Section 08 80 00: Glazing.
   4. Section 09 21 16: Gypsum Board Assemblies.
   5. Section 09 24 00: Cement Plastering.
   6. Section 09 90 00: Painting and Coating.

C. Reference Standards:
   1. ASTM International (ASTM)
      a. A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      b. A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
      c. A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
      d. A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
      e. C1363 Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
      f. E283 Standard Test Method for Determining the rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
      g. E413 Standard Classification for Rating Sound Insulation.
   2. Hollow Metal Manufacturers Association (HMMA):
      a. HMMA 802 Manufacturing of Hollow Metal Doors and Frames.
      b. HMMA 810 Hollow Metal Doors.
      c. HMMA 830 Hardware Preparation and Locations for Hollow Metal Doors and Frames.
      d. HMMA 840 Installation and Storage of Hollow Metal Doors and Frames.
      e. HMMA 850 Fire Rated Hollow Metal Doors & Frames.
      f. HMMA 890 Technical Summary of Hollow Metal by HMMA.
   3. National Fire Protection Association (NFPA):
      a. 80 Fire Doors and Fire Windows.

b. 252 Fire Tests of Door Assemblies.
4. Steel Door Institute – Current Standards: Technical Data Series.
5. Underwriters Laboratories Inc. (UL):
   a. Building Materials Directory.
   b. Listing and Labeling.
   c. 10B and 10C Fire Tests of Door Assemblies.
   d. 1784 Air Leakage Tests of Door Assemblies.
6. Intertek Testing, Services (Warnock Hersey, Inc. (WHI): Listing and Labeling.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
   2. Manufacturer's installation instructions.

B. Shop Drawings:
   1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the contract Drawings. If any door is not by the steel door manufacturer, only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.):
      a. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.

C. Samples are required from non-Steel Door Institute members:
   1. 12-inch by 12-inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
   2. 12-inch by 12-inch sample of each type of door louver specified or required, showing louver construction.
   3. Six-inch (6”) long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.

D. Certificates: Manufacturer’s certification that oversized openings are in compliance with specifications.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: If other than a manufacturer listed under Paragraph 2.1 is proposed for use on the Project, it shall be a company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of five (5) years’ experience.

B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer’s insignia, which is being supplied.

C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.

D. ANSI A250.13 Testing and Rating of Sever Windstorm Resistant Components for Swing Door Assemblies.

E. ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

F. Comply with ASTM E283 Standard Test Method for Determining the Rate of Air Leakage

Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

G. Regulatory Requirements:
1. Fire-Rated Assemblies:
a. Fire-rated door, panel, frame, and fire window construction shall conform to NFPA 252, or UL 10B, as applicable, and acceptable to the code of authorities having jurisdiction.
b. Fire-rated door construction:
1) Notwithstanding any other requirements of this Section, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20-minute, 45-minute, 1-hour, 1-1/2-hour, 3-hour, etc.) and the designation (A, B, C, D, or E); doors with B Label shall be 1-1/2 hour.
2) Fire-rated doors used in a stairway enclosure, shall be so constructed so that the maximum transmitted temperature shall not exceed 450 degrees F above ambient temperature at the end of 30 minutes of the Standard Fire Exposure Test and shall be so noted on the label.
c. Fire-rated openings:
1) Conform to NFPA 80 for fire-rated class shown or required by code of authorities having jurisdiction:
a) Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified above, and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code of authorities having jurisdiction.
b) Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.
c) Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.
d) Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.
e) Locate label on hinge side of doors and frames so that when door is closed, label is not visible.
f) Caution shall be taken to ensure that labels are not removed, damaged, or painted over.
g) Glass panes shall not exceed sizes allowed whether indicated or not on the Drawings.

H. Wind Loads: Provide hollow metal and door hardware assemblies approved by DSA, including anchorage, capable of withstanding wind load design pressures that are calculated for this Project by a registered Architect or Engineer and is part of the construction documents per CBC.

I. Accessibility Requirements:
1. Comply with applicable requirements:
a. Americans with Disability Act of 1990, as amended: 2010 ADA Standards.
b. CBC 2019 California Building Code. CCR Title 24, Part 2, as adopted and amended by DSA.

J. Pre-Installation Conference: Refer to Section 01 31 00: Project Management and Coordination.

1.5 WARRANTY

A. Warrant the work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

B. Defects shall include, but not be limited to:
1. Use of incorrect materials in opening.
2. Incorrect labeled components installed within opening.
3. Noisy, rough, or difficult operation.
4. Failure to meet specified quality assurance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in accordance with manufacturer’s instructions, and as follows:
1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
2. Containers or wrappers shall list the name of the manufacturer and product.

B. Deliver materials to allow for minimum storage time at the Project site. Coordinate delivery with the scheduled time of installation.

C. Protect products from moisture, construction traffic, and damage:
1. Store under cover in a clean, dry place, protected from weather and abuse.
2. Store in a manner that will prevent rust or damage.
3. Store doors in a vertical position, spaced with blocking to permit air circulation.
4. Do not use non-vented plastic or canvas shelters.
5. Should containers or wrappers become wet, remove immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must comply with Manufacturer Qualifications, must manufacture equivalent products to those specified, and comply with requirements of Section 01 25 00: Substitution Procedures, regarding substitutions to be considered:
1. CECO Door Products, Brentwood, TN; (615) 661-5030.
2. Curries Company, Mason City, IA; (515) 423-1334.
3. Pioneer Industries, Inc., Kewanee, IL; (309) 856-6000.
4. Republic Builders Products Company, McKenzie, TN; (800) 733-3667.
5. Steelcraft Mfg. Co., Cincinnati, OH; (513) 745-6400.
6. Approved equal.

2.2 MATERIALS, GENERAL

A. Steel requirements, all frames to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel per ASTM A1008 general requirements. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM A1011. Exterior frames and interior frames where shown on Drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvannealed to A-60 minimum coating weight standard per ASTM A653 and A924, with coating weight of not less than 0.60 ounce per square foot (0.30 ounce per square foot per side).

2.3 FRAME FABRICATION

A. Minimum Gauges:
1. Interior openings:
   a. Less than four feet (4') width: 16 gauge.
   b. Four feet (4') in width and greater: 14 gauge.
2. Exterior openings: 14 gauge

B. Design and Construction:
1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacenT100-degree walls shall have at least four-inch (4") wide frame face to assure the door trim will not strike the wall prior to the door opening at leasT100 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4-inch at four-inch (4") CMU, 6-3/4-inch at six-inch (6") CMU, and 8-3/4-inch at eight-inch (8") CMU. At masonry wall openings, fabricate frames to suite masonry opening with two-inch (2") head member.
2. Frames shall be strong and rigid, neat in appearance, square, true, and free of defects, warp, and buckle. Molded members shall be clean cut, straight, and of uniform profile throughout their length.
3. Jamb depths, trim, profile, and backbends shall be as shown on approved shop drawings.
4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
5. Minimum depth of stops shall be 5/8 inch, except at fire windows where minimum depth of stops shall be 3/4 inch.
6. Frames for multiple openings shall have mullion and rail members that are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to Owner's Best system.
7. High frequency hinge reinforcement: Provide high frequency hinge reinforcements at door openings 48-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous hinge reinforcement: Provide welded continuous 12-gage strap for continuous hinges specified in hardware sets in Division 08 Openings.
9. Provide countersunk flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
10. Provide A60 galvannealed coating at frames in restrooms and locker rooms with showers/Jacuzzi, clean areas such as kitchen rooms.
11. Electrical knock out boxes:
    a. Factory weld 18-gage electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic licks as noted in door hardware sets in Division 08 Openings:
       1) Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations.
       2) Provide electrical knock out boxes with 3/4-inch knockouts.
       3) Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
       4) Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Openings.
       5) Electrical knock out boxes for continuous hinges should be located in the

center of the vertical dimension on the hinge jamb.

6) Provide field installed conduit per Division 28: Electronic Safety & Security Section for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 08 Openings. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.

12. Hardware reinforcements:
    a. Frames shall be mortised, reinforced, drilled, and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 06 71: Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
    b. Minimum thickness of hardware reinforcing plates shall be as follows:
        1) Hinge and pivot reinforcements (1-1/4-inch x 10-inch minimum size): Seven (7) gauge.
        2) Strike reinforcements: 12-gauge stiffeners.
        3) Flush bolt reinforcements: 12-gauge.
        4) Closer reinforcements: 12-gauge.
        5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12-gauge.
13. Floor anchors: Minimum 14-gauge, securely welded inside each jamb, with holes for floor anchorage.
14. Jamb anchors:
    a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16-gauge steel. The number of anchors provided at each jamb shall be as follows:
        1) Frames up to seven-feet-six-inches (7’-6”) in height: Three (3) anchors.
        2) Frames seven-feet-six-inches (7’-6”) to eight feet (8’) in height: Four (4) anchors.
        3) Frames over eight feet (8’) in height: One (1) anchor for each two feet (2’) or fraction thereof in height.
    b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16-gauge thickness, securely welded inside each jamb as follows:
        1) Frames up to seven feet six inches (7’-6”) in height: Four (4) anchors.
        2) Frames seven feet six inches (7’-6”) to eight feet (8’) in height: Five (5) anchors.
        3) Frames over eight feet (8’) in height: Four (4) anchors plus one (1) additional for each two feet (2’) or fraction thereof over eight feet (8’).
    c. Frames to be anchored to previously placed concrete, masonry, or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
15. Dust cover boxes: Shall be of not less than 26-gauge steel and shall be provided at all mortised hardware items. Eight-inch (8”) CMU walls with face brick shall have dual offset jamb anchors.
16. Steel spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
17. Loose glazing stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
18. Unless otherwise noted on Drawings, ALL doors coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch.

C. Frame Color: Field painted under Section 09 90 00: Painting and Coating to match face of

door.

2.4 DOOR FABRICATION

A. Minimum Gauges
1. Interior doors: 0.047 inch or 18 gauge (16 gauge for high frequency doors).Exterior doors: 0.059 inch or 16 gauge (14 gauge for windstorm rated doors).Design and Construction:
2. Types: Doors shall be custom fabricated, of types and sizes shown on approved shop drawings, and shall be seamless face construction with no visible seams or joints on vertical edges with fully welded seams free from blemishes and defects.Thickness shall be 1-3/4 inch, unless specifically noted or shown otherwise.Exterior doors: Provide doors with 22-gage steel z-channels placed at six inches (6”) apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
3. Fabrication:
   a. Doors shall be strong, rigid, and neat in appearance, free from warpage and buckle.
   b. Corner bends shall be true and straight and of minimum radius for gage of metal used.
   c. Provide stiffeners with polystyrene core spaced maximum six inches (6”) on center and extending full height of door.
   d. Fill interior with noncombustible fiberglass insulation. Use mineral board filler as required for labeled doors.
   e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled, and dressed smooth to provide a smooth flush surface.
   f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
   g. Continuous hinge reinforcement: Provide welded continuous 12-gage strap for continuous hinges specified in hardware sets in Division 08: Openings.
   h. Electrical raceways: Provide raceways for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Division 08: Openings. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
   i. Doors in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
   j. Edge profile shall be provided on both vertical edges of door as follows:
      1) Single-acting swing doors: Beveled 1/8 inch in two inches (2”).
   k. Hardware reinforcements:
      1) Doors shall be mortised, reinforced, drilled, and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00: Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
      2) Minimum gauges for hardware reinforcing plates shall be as follows:
         a) Hinge and pivot reinforcements: Seven (7) gauge.
         b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
4. Glass moldings and stops: Loose stops shall be not less than 20-gauge steel, with

butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.

5. Louvers: Shall be inverted "V" blade, sight-proof type, unless noted otherwise.
6. Edge clearances:
   a. Between door and frame at head and jambs: 1/8 inch.
   b. At doorsills with no threshold: 5/8-inch to 3/4-inch above finished floor.
   c. At doorsills with threshold: As required to suit threshold.
   d. Between meeting edges of double doors: 1/8 inch.

B. Finish:
   1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
      a. Clean surfaces free of mill scale, rust, oil, grease, dirt, and other foreign matter.
      b. Chemically treat surfaces and apply one (1) coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.

   2. Field painted under Section 09 90 00: Painting and Coating.

C. Sound Rated Door: STC of 32, measured in accordance with ASTM E413.

D. Thermal Insulated Door: Total insulation R-Value of 44 measured in accordance with ASTM C1363, unless otherwise noted on Drawings.

2.5 LABELED DOORS AND FRAMES

A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.

B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware, or other reason, the Architect shall be so advised before fabrication work on that item is started. Indicate and highlight on shop drawing.

PART 3 EXECUTION

3.1 COORDINATION

A. Coordinate the work of this Section.

B. Coordinate hardware installation with opening construction. Finish hardware is specified in Section 08 06 71: Door Hardware.

C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00: Glazing.

D. Coordinate doors and frames with painting specified in Section 09 90 00: Painting and Coating.

3.2 INSTALLATION

A. Separate dissimilar metals. Protect against galvanic action.

B. Frames:

1. Anchorage and connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180-degree door swing.
2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
3. Frame spreader bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.

C. Doors:
1. Install hardware in accordance with hardware manufacturer's templates and instructions.
2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
3. Adjust operable parts for correct function.
4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

3.3 ADJUST AND CLEAN

A. Adjust doors for proper operation, free from binding or other defects.

B. Clean and restore soiled surfaces.

C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION 08 11 13

THIS PAGE WAS INTENTIONALLY LEFT BLANK

SECTION 08 31 13 – ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Access doors in gypsum board, masonry partitions, and plaster/stucco soffits, where shown or required.

1.3 SUBMITTALS

A. Product Data:
1. Manufacturer's literature, including schedules, charts, and illustrations to indicate the performance, fabrication, procedures, product variations, and accessories.
2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing access doors meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.
1. The Bilco Company, (
2. Acudor Products, Inc., Cedar Grove, NJ.
3. Babcock-Davis (Cierra Products), Garland, TX.
4. Bar-co, Alfab, Inc., Enterprise, AL.
5. J. L. Industries, Incorporated, Bloomington, MN.
6. Karp Associates, Inc., Maspeth, NY.
7. Larsen's Manufacturing Company, Minneapolis, MN.
8. Milcor LP, Holland, OH.
9. Nystrom Building Products Co. Inc., Minneapolis, MN.
10. The Williams Brothers Corporation of America, Front Royal, VA.

B. Specifications are based on products of Babcock-Davis, Garland, TX; (888) 412-3726.

2.2 PRODUCTS

A. General: The following access panel types are for selection as required whether or not indicated on drawings. The contractor shall evaluate the specific requirements and provide the appropriate system based on the condition, as all types may not be required on the project. The inclusion of any of the listed access panel types does not necessarily imply that the condition exists in the scope of work.

B. Standard type flush steel door for exterior masonry construction:
   1. Size: 2 feet-0 inches x 3 feet-0 inches unless otherwise noted in drawings or specifications. Coordinate size with clearances for equipment being accessed.
   2. Hinges: Stainless steel concealed continuous piano type hinges.
   3. Frames: 6063-T5 extruded aluminum frame. Mill finish
   4. Doors: 20 gauge galvanized steel. Phosphate dipped and prime coated for field painting per Section 09900.
   5. Latch and Lock: Two (2) dual acting handles with exterior lock.
   6. Gasketing: Extruded santoprene
   7. Insulation: 2 inch thick fiberglass
   8. Approved Product: Model “B-XT”, or Architect approved equal.

C. Standard type flush steel door for wallboard and masonry construction:
   1. Size: 2 feet-0 inches x 2 feet-0 inches unless otherwise noted in drawings or specifications. Coordinate size with clearances for equipment being accessed.
      a. Provide 12 inch x 12 inch access panels at all motorized overhead coiling doors, grilles, and coiling counter doors that are located within non-removable ceilings for access to motors for repairs and maintenance of electric operators.
   2. Hinges: Concealed continuous piano type hinges.
   3. Finish: Phosphate dipped and prime coated for field painting per Sections 01 0 16 – Interior Design Selections and 09 90 00 – Paintings and Coatings.
   4. Frames: 16 gauge galvanized steel with 22 gauge galvanized wallboard corner bead
   5. Doors: 14 gauge galvanized steel.
   6. Lock: Flush screw driver operated cam.
   7. Approved Product: Model “B-NW”, or Architect approved equal.

D. Standard type flush stainless steel door for ceramic tile:
   1. Size: 10 inch x 10 inch unless otherwise noted in drawings or specifications. Coordinate size with clearances for equipment being accessed.
   2. Hinges: Concealed continuous piano type hinges.
   3. Finish: #4 satin polish.
   4. Frames: 16 gauge type 304 stainless steel with 1 inch drywall bead.
   5. Doors: 16 gauge type 304 stainless steel.
   6. Lock: Key operated latch bolt.
   7. Approved Product: Model “BRUW”, or Architect approved equal.

E. Standard type flush steel door for plaster/stucco soffit construction:
   1. Size: Coordinate size with clearances for equipment being accessed. As shown on the drawings.
   2. Hinges: Concealed continuous piano type hinges.
   3. Finish: Phosphate dipped and prime coated for field painting per Sections 01 0 16 – Interior Design Selections and 09 90 00 – Paintings and Coatings.
   4. Frames: 16 gauge galvanized steel with 22 gauge galvanized plaster casing bead
   5. Doors: 14 gauge galvanized steel.
   6. Lock: Flush screw driver operated cam.
   7. Approved Product: Model “B-NP”, or Architect approved equal.

F. Fire rated flush steel door for wallboard construction:
1. Listing: UL listed 'B' label up to 1-1/2 hours in walls and Warnock-Hershey listed up to 3 hours in ceilings.
2. Size: As shown on the drawings.
3. Hinges: Concealed pin hinge
4. Finish: Phosphate dipped and prime coated for field painting per Section 09 90 00.
5. Frames: 16 gauge galvanized steel with 22 gauge galvanized wallboard corner bead
6. Doors: 20 gauge galvanized steel.
7. Lock: Knurled knob/key operated latch bolt.
8. Insulation: 2 inch thick fire rated mineral fiber
9. Approved Product: Model "B-IW", or Architect approved equal.

G. Insulated access panel for valve box in exterior brick wall:
1. Size: 12 inches x 12 inches, or as required for application.
2. Door: 0.060 6063-T5 extruded aluminum.
3. Frame: 0.060 6063-T5 extruded aluminum.
4. Hinge: Stainless steel concealed piano hinge.
5. Latch: Hex head cam latch operable with standard allen wrench.
6. Flange: 0.080 6063-T5 extruded aluminum.
7. Finish: Paint grip.
8. Insulation: Two (2) inch thick fiberglass.
9. Gasket: Extruded Sanoprene.
10. Approved Product: Model "B-XT", or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and provide panels to the trade that is constructing the material being penetrated.

3.2 LOCATIONS

A. Provide where required by code and where needed to service and maintain equipment.

B. If not shown on the drawings, consult the Architect before locating in finished spaces.

END OF SECTION 08 31 13

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, including Sections 01 60 13 and 01 60 16, apply to this Section.

B. Section 01 60 13 – Architectural Design Selections

C. Section 01 60 16 – Interior Design Selections

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Service doors.
   2. Insulated service doors.
   3. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, licensed in the State of Texas, using performance requirements and design criteria indicated.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
   1. Testing: According to ASTM E 330.
   2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
   3. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283].

D. STC Rating: 26.

E. Curtain R-Value: 5.0 degrees F x h x sq. ft./Btu (0.881 K x sq. m/W).

F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 100,000 cycles for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
   1. Include tamperproof cycle counter.

1.4 SUBMITTALS

A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
   2. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: Submit plans, elevations, sections, and mounting details.
   1. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, and other accessories.
   6. Include diagrams for power, signal, and control wiring.

C. Samples: Submit samples for exposed metal finish in standard sizes.

D. Delegated Design Submittal: Submit delegated design including analysis data signed and sealed by the professional engineer licensed in the State of Texas who is responsible for the preparation.

E. Oversize Construction Certification: For door assemblies required to be fire rated and that exceed size limitations of labeled assemblies.

F. Maintenance Data: Submit for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
      a. Smoke Control: Where indicated, provide doors that are listed and labeled with the letter "S" on the fire rating label by a qualified testing agency for smoke and draft control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.

   2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire rated door assemblies except for size.
   4. Temperature Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.
   5. Smoke Control: In corridors and smoke barriers, provide doors UL listed and labeled with the letter "S" on the fire rating label for smoke and draft control based on testing according to UL 1784; with maximum air leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10 inch wg (24.9 Pa) for both ambient and elevated temperature tests.
   6. Sound Control Doors: Assemblies tested in a laboratory for sound transmission loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
   7. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS).

B. Installer Qualifications: Entity having minimum 5 years documented experience who employs installers and supervisors trained and approved by manufacturer for both installation and maintenance of units required.

C. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling door manufacturer.

1.6 WARRANTY

A. Finish Warranty: Provide manufacturer's standard finish warranty against rusting.
1. Warranty period: ten (10) years.

B. Delamination Warranty: Provide manufacturer's standard warranty against delamination.
1. Warranty period: ten (10) years.

PART 2 - PRODUCTS

2.1 DOOR ASSEMBLY

A. Manufacturers: Basis of Design; Overhead Door Corporation. Subject to compliance with requirements, provide products by one of the following:
1. Clopay Building Products.
2. Cookson Company.
3. Cornell Iron Works, Inc.
4. McKeon Door Company, Inc. as distributed by Griesenbeck.
5. Overhead Door Corporation.
6. Wayne-Dalton Corp.
7. Holiday Gate & Door Systems Inc.

B. Service and/or Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

C. Door Curtain Slats:
1. Flat profile slats of **2-5/8 inch (67 mm)** center to center height.
2. Gasket Seal. Continuous gaskets between slats.

D. Bottom Bar: Two angles, each not less than 1-1/2 inch by 1-1/2 inch by 1/8 inch (38 mm by 38 mm by 3 mm) thick; fabricated from aluminum with mill finish.

E. Curtain Jamb Guides: **Galvanized steel** with exposed finish matching curtain slats.

F. Hood: Match curtain material and finish
1. Shape: **Square**.
2. Mounting: Face of wall

G. Locking Devices: Equip door with slide bolt for padlock
1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside and outside with cylinders.

H. Electric Door Operator:
1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: **Top of hood**
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.

4. Motor Exposure: Interior
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom bar
   a. Sensor Edge Bulb Color: Black.
7. Control Station(s): Where shown on Drawings.

I. Door Finish:
1. Bottom Bar Aluminum Finish: Mill
2. Baked Enamel or Powder Coated Finish: Selected by Architect.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Steel Door Curtain Slats: Zinc coated (galvanized), cold rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
2. Insulation: Fill slats for insulated doors with thermal insulation complying with maximum flame spread and smoke developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.

B. Curtain Jamb Guides: Angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.3 HOODS

A. Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface mounted hoods and fascia for any portion of between jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028 inch (0.71 mm) thick, hot dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Stainless Steel: 0.025 inch (0.64 mm) thick stainless steel sheet, Type 304, complying with ASTM A 666.
3. Aluminum: 0.040 inch (1.02 mm) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
4. Include automatic drop baffle on fire rated doors to guard against passage of smoke or flame.
5. Exterior Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant joint bead profile for applying joint sealant.

2.4 LOCKING DEVICES

A. Slide Bolt: Fabricate with side locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Refer to Section 08 06 71.
2. Keys: Refer to Section 08 06 71.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather stripping gaskets fitted to entire exterior perimeter of door for weather resistant installation unless otherwise indicated.
1. At door head, use 1/8 inch (3 mm) thick, replaceable, continuous sheet baffle secured to inside of hood or field installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8 inch (3 mm) thick seals of flexible vinyl, rubber, or neoprene.

B. Astragal for Interior Doors: Equip each door bottom bar with replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

C. Push/Pull Handles: Equip each push up operated or emergency operated door with lifting handles on each side of door, finished to match door.

D. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

2.6 COUNTERBALANCING MECHANISM

A. Counterbalance doors using standard mechanism with adjustable tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of hot formed, structural quality, seamless or welded carbon steel pipe, of sufficient diameter and wall thickness to support rolled up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil tempered, heat treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast steel barrel plugs.
1. Fire Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of cold rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Mounting brackets fabricated from either cast iron or cold rolled steel plate.

2.7 ELECTRIC DOOR OPERATORS

A. Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation cycles requirement specified, with electric motor and factory prewired motor controls, starter, gear reduction unit, solenoid operated brake, clutch, control

stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.
1. Top of Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
2. Front of Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
5. Through Wall Mounted: Operator is mounted on other side of wall from coil side of door.

D. Motors: Reversible type motor with controller (disconnect switch) for motor exposure indicated.
1. Electrical Characteristics:
   a. Phase: Polyphase.
   b. Volts: 115 V.
   c. Hertz: 60.

2. Motor Size: Minimum size large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For nonfire rated doors, activation of device immediately stops and reverses downward door travel. For fire rated doors, activation delays closing.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
   a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using take up reel or self-coiling cable.

a. Self-Monitoring Type: Four wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three button control station in fixed location with momentary contact push button controls labeled *Open* and *Stop* and sustained or constant pressure push button control labeled *Close*.
1. Interior Mounted Units: Full guarded, surface mounted, heavy duty type, with general purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior Mounted Units: Full guarded, standard duty, surface mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.8 FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Steel and Galvanized Steel Finishes:
1. Factory Prime Finish: Standard primer, compatible with field applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
2. Baked Enamel or Powder Coat Finish: Baked on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory authorized service representative to perform startup service.
   1. Perform installation and startup checks according to manufacturer's written instructions.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
   3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so doors operate easily, free of warp, twist, or distortion. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 08 41 13 – ALUMINUM FRAMED ENTRANCE AND STOREFRONT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 13 – Exterior Design Selections.

C. Section 01 60 16 – Interior Design Selections.

D. Section 07 92 00 – Joint Sealants.

E. Section 08 06 71 – Door Hardware.

F. Section 08 80 00 – Glazing.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Exterior and interior storefront framing.
2. Exterior and interior manual swing entrance doors.
3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 PERFORMANCE REQUIREMENTS

A. Performance: Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
    a. Deflection exceeding specified limits.
    b. Thermal stresses transferring to building structure.
    c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    d. Noise or vibration created by wind and by thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Sealant failure.
    g. Failure of operating units.

B. Structural Loads:
1. Wind Loads: Indicated on Drawings.

C. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

~~F.~~ Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure.

G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C).

H. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

I. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.5 SUBMITTALS

A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.

B. Shop Drawings: Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other Work.
1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

D. Engineer's calculations of performance requirements.

E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.

C. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.

F. Preinstallation Conference: Conduct conference at site.

G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Perform testing on mockups according to specified requirements.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Water leakage through fixed glazing and framing areas.
      d. Failure of operating components.

   2. Warranty Period: Two (2) years from date of Substantial Completion.

B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: Ten (10) years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:
   1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
   2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design: Kawneer Trifab 451/451T (Product Evaluation CWSF-34), impact resistant system, maximum design pressure +/- 45 psf. Subject to compliance with requirements, provide comparable storefront system by one of the following:
   1. EFCO Corporation.
   2. Old Castle Building Envelope
   3. Tubelite, Inc.
   4. US Aluminum Corporation.
   5. YKK America AP, Inc.

B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   3. Extruded Structural Pipe and Tubes: ASTM B 429.
   4. Structural Profiles: ASTM B 308/B 308M.

C. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
   1. Construction: Thermal.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Front.

D. Accessories:
   1. Brackets and Reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
   2. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
      a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
      b. Reinforce members as required to receive fastener threads.
   3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
   4. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
   5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.

E. Glazing: Refer to Section 08 80 00 – Glazing for impact resistant laminated insulating glass with low-e coating on Number 2 surface.
   1. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
   2. Spacers and Setting Blocks: Elastomeric type.

F. Entrance Doors: Glazed entrance doors for manual swing operation.
   1. Door Construction: 1-3/4 inch ((44.5 mm)) overall thickness, with minimum 0.125 inch ((3.2 mm)) thick, extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   2. Door Design: Nominal width of 6 inch vertical and top stiles and 10 inch bottom rail.
   3. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.

G. Entrance Door Hardware: Refer to Section 08 06 71 – Door Hardware for aluminum entrance hardware sets.
   1. Basis of Design: Series 500 Wide Stile, swing door standard as manufactured by Kawneer Co., Inc. or equivalent product from list of approved manufacturers.
   2. Provide entrance door hardware and entrance door hardware sets indicated Door Hardware Specification Section 08 71 00 for each entrance door to comply with requirements in this Section.
      a. Opening-Force Requirements:
         1) Egress Doors: Maximum than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
         2) Interior Doors: Maximum 5 lbf to fully open door.
      b. Weather Stripping:
         1) Meeting stiles on pairs of doors shall be equipped with an adjustable astragal using wool pile with polymeric fin.

2) The door weather on a single-acting offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tabular shape with a semi-rigid polymeric backing..

c. EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (necessary to meet specified performance tests).

H. Accessories:
1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 – Joint Sealants.
2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.2 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Framing Members: Fabricate components that, when assembled, have specified characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Provide sill receptors with end dams at all sill conditions.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Storefront Framing: Fabricate components for assembly using screw spline system.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide weather stripping at fixed stops.
2. At interior doors, provide weather stripping at stops to prevent metal to metal contact.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.3 ALUMINUM FINISHES

A. Baked Enamel or Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Color and Gloss: Reference 01 60 13 – Exterior Design Selections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
   1. Do not install damaged components.
   2. Fit joints to produce hairline joints free of burrs and distortion.
   3. Rigidly secure nonmovement joints.
   4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   5. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing specified in Section 08 80 00.

G. Entrance Doors and Hardware: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field Installed Entrance Door Hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 07 92 00 to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
   1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 08 41 13

SECTION 08 44 13 – GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Glazed aluminum curtain walls.
   2. Perimeter sealant.
   3. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

A. Section 01 60 13 – Exterior Design Selections: Finish and colors.

B. Section 03 30 00 – Cast-In-Place Concrete: Weld plates embedded in concrete for attachment of anchors.

C. Section 05 12 00 – Structural Steel Framing: Steel attachment members.

D. Section 07 84 00 – Firestopping: Firestop at system junction with structure.

E. Section 07 92 00 – Joint Sealants: Perimeter sealant and back-up materials.

F. Section 08 80 00 – Glazing.

G. Section 09 90 00 – Paintings and Coatings: Field painting of interior surface of infill panels.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of curtainwalls and aluminum storefronts to design glazed aluminum curtain walls using performance requirements and design criteria indicated.

B. Provide curtain wall assembly by a single source and tested as a combined single assembly.

C. System Description: Curtainwall assembly fabricated from aluminum stick framed system with exposed interior and exterior metal framing. Design system to allow for installation tolerances, expansion and contractor of adjacent materials and joint design.
   1. Drawings are diagrammatic and do not identify or solve thermal or structural movement, glazing, anchorage, or moisture disposal. Details establish basic dimension of unit, sight lines, and profiles of members.

2. Glass, sealants, and interior finishes do not contribute to framing member strength, stiffness, or lateral stability.
3. Design and fabricate glazing systems for interior glazing.
4. Design perimeter conditions to allow for installation tolerances, expansion and contraction of adjacent materials, and sealant manufacturer's recommended joint design.
5. Design attachments to address site conditions, expansion, and contraction movements to eliminate possibility of loosening, weakening, or fracturing connection between units and building structure or between units themselves.
6. Allow for expansion and contraction due to structural movement without detriment to appearance or performance.
7. Design system to drain to exterior face of wall, water entering joints and condensation occurring within system by drain holes and gutters of adequate size to evacuate water without infiltration to interior or the top of lower lites of glass.
8. Design metal faces to be visually flat under lighting conditions.
9. Design Interior dense EPDM wedge gasket with sealed corners, with maximum 30% compression when glazed, to create a water and air seal.
10. Design rigid isolators to maintain flatness of face caps and provide thermal break between exterior and interior members.
11. For stresses placed on structural silicone sealants, maintain sealant manufacturer's recommended maximum.
12. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

D. Performance Criteria: Provide curtain wall assemblies to meet or exceed performance requirements:
1. Design and fabricate curtain wall to withstand the operating loads without measurable permanent deflection. Limit deflections to provide the normal degree of rigidity required to avoid glass breakage, air infiltration, and objectionable results of excessive flexibility.
2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
3. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

E. Structural Loads:
1. Wind Loads: Design, fabricate, and install framing system to withstand the maximum inward and outward wind pressures required by IBC.
   a. Basic Wind Speed: Refer to Structural Drawings.
   b. Exposure Category: Refer to Structural Drawings.
   c. Risk Category: Refer to Structural Drawings.

2. Deflection of Framing Members: At design wind pressure:
   a. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
   b. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
      1) Operable Units: Provide a minimum 1/16-inch (1.6 mm) clearance between framing members and operable units.
   c. Cantilever Deflection: Where framing members overhang an anchor point:
      1) Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6. 35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
   d. Do not permit permanent deformation (set) in metal framing Work. Permanent deformation, fastener, weld, or gasket failure, component breakage or disengagement shall not occur under wind loading equal to 1.5 times the wind loads (positive or negative). Permanent deformation shall be taken as deflection without recovery exceeding 1/1000 times span.

F. Structural: Test according to ASTM E 330:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

G. Air Infiltration: Test according to ASTM E 283 for infiltration:
   1. Fixed Framing and Glass Area:
      a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq.m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

H. Water Penetration under Static Pressure: Test according to ASTM E 331:
   1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 psf (575 Pa) as defined in AAMA 501.

I. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1:
   1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less 12 psf (575 Pa) as defined in AAMA 501.
   2. Maximum Water Leakage: According to AAMA 501.1 Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

J. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: Indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement.

K. Energy Performance: Certify and label energy performance according to NFRC:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.66 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.23 as determined according to NFRC 200.
3. Condensation Resistance: When tested using AAMA 1503, the CRF frame and CRF glass (with low-emissivity glazing) shall not be less than 71 and 71 respectively. Excessive condensation is defined as the accumulation of uncontrolled condensate flowing from the curtain wall at any location, or visible ice, frost, or water on more than 5% of the area of any module of the exterior wall.

L. Noise Reduction: Test according to ASTM E 90 and ASTM E 1425, with ratings determined by ASTM E 1332:
1. Outdoor/Indoor Transmission Class (OITC): Minimum 26 based upon 1" (25.4 mm) insulating glass (1/4", 1/2" AS, 1/4"), and 30 based upon 1" (25.4 mm) laminated glass (1/4" laminated, 1/2" AS, 1/4" laminated).

M. Sound Transmission Loss: Provide window wall and storefront systems with fixed glazing and framing areas having sound transmission characteristics of:
1. Sound Transmission Class (STC): Minimum 31 standard and 37 laminated STC when tested for laboratory sound transmission loss according to ASTM E 90 and ASTM E 1425 and determined by ASTM E 413.

N. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
   a. High Exterior Ambient Air Temperature: That which produces an exterior metal surface temperature of 180 degrees F (82 degrees C).
   b. Low Exterior Ambient Air Temperature: 0 degrees F (minus 18 degrees C).

O. Structural Sealant Joints:
1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).

P. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural sealant glazed curtain walls without failing adhesively or cohesively.

When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

Q. Design Modifications: Submit design modifications necessary to meet performance requirements and field coordination.

1. Variations in details or materials shall not adversely affect the appearance, durability, or strength of components, nor shall variations cause excessive stress, or deflections, to building structural frame.
2. Maintain general design concept without altering size of members, profiles, and alignment.

1.5 SUBMITTALS

A. Combined Submittals: Combine submittals for exterior curtainwall and storefronts into a single submission. Submit combined shop drawing which has been reviewed, annotated, and coordinated by each of the principal exterior cladding subcontractors.

1. As an indication of review, and as a condition of acceptance by the Architect, provide combined submittal with a cover sheet clearly indicating the signatures of the Contractor and each exterior cladding subcontractor.
2. Coordinate curtainwall, storefronts and entrances, windows, ACM, and window wall submittals.

B. Product Data: Manufacturer technical data for each type of product, including construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: Submit plans, elevations, sections, full size details, and attachments to other Work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full size isometric details of each vertical to horizontal intersection of glazed aluminum curtain walls, showing the following:
    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.
    f. Thermal breaks.
    g. Interface with building construction.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Indicate glazing details, methods, locations of various types and thickness of glass, emergency breakout locations, and internal sealant requirements.
5. Indicate locations of exposed fasteners and joints for Architect's acceptance.

D. Fabrication Sample (Mock-Up Drawings): Submit drawings for field mockup of each vertical to horizontal intersection of assemblies, made from 12-inch (300 mm) lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.
   5. Flashing and drainage.

E. Delegated Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for the preparation.

F. Structural Calculations: Submit sealed copies of structural calculations indicating complete compliance with the specified performance requirements. Submit calculations prepared, signed, and sealed by a Professional Engineer licensed in the State of Texas.

G. Preconstruction Laboratory Mock-Up Testing Submittals: Submit the following:
   1. Testing Program: Developed specifically for Project.
   2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
   3. Record Drawings: Record drawings prepared from as built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

H. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
   1. Basis for Certification: NFRC certified energy performance values for each glazed aluminum curtain wall.

I. Reports: Submit the following:
   1. Product Test Reports: Submit report for tests performed by a qualified testing agency.
   2. Quality Control Program: Program developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality control reports.
   3. Source quality control reports.
   4. Field quality control reports.

J. Maintenance Data: Submit maintenance data to include in maintenance manuals.

K. Maintenance Data for Structural Sealant: For structural sealant glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality control program.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of IBC.
   2. Energy Code: Comply with applicable provisions of the IECC.

3. Surface Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame Spread Index: 25 or less.
   b. Smoke Developed Index: 450 or less.
4. Accessibility Requirements: Comply with applicable requirements.
   a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
   b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
   c. Texas Accessibility Standards (TAS) 2012.
5. Welding Standards: Welding shall be performed by skilled and qualified mechanics. Welding shall be performed in accordance with the applicable provisions of AWS D1.1 Structural Welding Code - Steel and AWS D1.2 Structural Welding Code - Aluminum.
6. Federal Standard 16 CFR 1201, Consumer Product Safety Commission (CPSC): Safety Standard for Architectural Glazing Materials, published in Code of Federal Regulations (CFR).
   a. Comply with applicable requirements of authorities having jurisdiction, wherever requirements conflict the more stringent shall be required. Obtain approvals from authorities.
   b. As a minimum provide safety glazing complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
7. Structural Sealant Glazing: Comply with ASTM C 1401 for design and installation of structural sealant glazed curtain walls.
8. Energy Performance Standards: NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

B. Manufacturer/Fabricator Qualifications: Fabricator specializing in the fabrication of aluminum framed window wall and window systems and components, having minimum 10 years documented experience, and with sufficient production capacity, organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and install the entrance assemblies required.

C. Installer Qualifications: Firm that specializes in the erection of aluminum framed window wall, storefront, and window systems, having minimum 10 years documented experience, and approved or certified by manufacturer/fabricator.
1. Engineering Responsibility: Prepare data for curtainwall, storefront, and window systems, including Shop Drawings, based on testing and engineering analysis of manufactured units in systems similar to those indicated.
   a. Professional Engineer Qualifications: A professional engineer who is legally licensed to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of heavy glass storefront and entrance system similar to those indicated in material, design, and extent.

D. Laboratory Mock-up Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

E. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

G. Structural Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.

H. Source Limitations: Obtain components of curtain wall system, including framing, entrances, and accessories, from single manufacturer.

I. Preinstallation Conference: Conduct conference at site.

J. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings.
2. Perform testing on mockups according to specified requirements.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Preconstruction Laboratory Mockups:
1. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform testing on preconstruction laboratory mockups.
2. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.
   a. Size and Configuration: As indicated on Drawings.
   b. Notify Architect seven days in advance of the dates and times when preconstruction laboratory mockups will be constructed and tested.

3. Preconstruction Laboratory Mockup Testing Program: Test preconstruction laboratory mockups according to requirements. Perform the following tests in the following order:
   a. Structural: ASTM E 330 at 50 percent of positive test load.
   b. Air Infiltration: ASTM E 283.

c. Water Penetration under Static Pressure: ASTM E 331.
d. Water Penetration under Dynamic Pressure: AAMA 501.1.
e. Structural: ASTM E 330 at 100 percent of positive and negative test loads. Repeat the following:
   1) Air Infiltration: ASTM E 283.
   2) Water Penetration under Static Pressure: ASTM E 331.
f. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:
   1) Air Infiltration: ASTM E 283.
   2) Water Penetration under Static Pressure: ASTM E 331.
g. Vertical Interstory Movement: AAMA 501.7. Repeat the following:
   1) Air Infiltration: ASTM E 283.
   2) Water Penetration under Static Pressure: ASTM E 331.
h. Thermal Cycling: According to AAMA 501.5. Repeat the following:
   1) Air Infiltration: ASTM E 283.
   2) Water Penetration under Static Pressure: ASTM E 331.
i. Structural: ASTM E 330 at 100 and 150 percent of positive and negative test loads. Repeat the following:
   1) Air Infiltration: ASTM E 283.
   2) Water Penetration under Static Pressure: ASTM E 331.

L. Laboratory Mockup Testing: Curtain wall mock-up testing shall include components of fixed window units, glazed framing including captured mullions and SSG mullions, and storefront units in mock-up.
1. Laboratory Mock-up Testing: Provide mock-ups as specified for testing. Verify required mockup submittals are reviewed and have received final approval from the Architect prior to construction of the mockups.
   a. Laboratory testing mockups are used as a standard for judging visual and performance acceptability of the Work for the project. Replace unsatisfactory Work as directed. Provide personnel to construct exterior wall mock-ups who will be the same personnel who will be performing and supervising the actual Work. Simulate actual construction conditions as accurately as possible in every way. Provide extra materials necessary to replace any which fail during tests. Cut glass used in mock-ups to the minimum tolerances expected in the final exterior wall installation.
   b. Size: As shown but not less than the requirements of AAMA Standard 501 and ASTM E 331 Section 9. Provide larger mockup(s) if the proposed exterior wall details create a condition requiring a larger mock-up(s) for proper evaluation and testing. Provide mockups at wall testing facility complete with glass, aluminum framing, metal panels, anchors, connections, flashings, sealants, and joint fillers as accepted on the mockup shop drawings. Do not take special precautions or use techniques that do not represent those to be used on the Work.
   c. Laboratory Testing: Notify the Architect of the readiness of the mock-ups for preliminary and final testing. Do not begin the testing program without the presence of the Owner's representative and the Architect.
      1) Preliminary Test: Conduct single static pressure test at 50 percent of the maximum Wind Pressure followed by a single test for water penetration at 50 percent of the pressure specified.

a) The preliminary test is purposely limited to a single event. No interim or repeat preliminary testing for Contractor benefit or correction of systems shall be permitted.

2) Preform tests of the mock-up(s) in accordance with the standards except as modified, in the order listed, and in accordance with the specified performance criteria. Tests 1 and 5 shall be conducted at 1.57 lbf/sq. ft. (75 Pa) and 6.24 lbf/sq. ft. (300 Pa), respectively. Tests 2, 3, and 6 shall be conducted at 12 lbf/sq. ft. (600 Pa) for 1 cycle, maintaining the test pressure for 15 minutes.

a) Test 1 (For Air Infiltration): ASTM E 283. Extraneous air leakage (tare) shall be limited to 10 percent or less of the net air leakage through the exterior wall assembly as provided under ASTM E 283. Provide pressure taps as required within the test chamber to ensure uniform stratification of design test pressure across the exterior wall assembly.

b) Test 2 (For Water Penetration - Uniform Static Pressure): ASTM E 331.

c) Test 3 (For Water Penetration - Dynamic Pressure): AAMA 501.1.

d) Test 4 (For Structural Performance): ASTM E 330, Method B, test to .5, and 1.0 times the wind pressure, during test. Deflection readings shall be taken at end connections and midspans of main framing members, at intersections of framing members and at midspans of glass holding members, glass, and panels. Take readings for both positive and negative loading. If failure occurs through glass breakage prior to achieving 1.5 times the maximum wind pressure, replace glass and repeat test. Two successive failures of the same light or panel not otherwise attributable to inherent glass defects will be considered unacceptable. Further tests shall be suspended until deficiencies are corrected, which may include increasing the stiffness of glass holding members and/or adjustment of the glazing details.

e) Test 5 (Retest for Air Infiltration): ASTM E 283. Extraneous air leakage (tare) shall be limited to 10 percent or less of the net air leakage through the exterior wall assembly as provided under ASTM E 283. Provide pressure taps as required within the test chamber to ensure uniform stratification of design test pressure across the exterior wall assembly.

f) Test 6 (Retest for Water Penetration, Uniform Static Pressure): ASTM E331.

g) Test 7 (For Structural Performance): ASTM E 330, Method B, except conduct test to 1.5 times

the maximum wind pressure. Record pressures and deflections at 1.5 times the wind pressure, during test.

h) Test 8 (For Live Load Deflection Performance): AAMA 501.4 Modified. Test for live load deflection by applying vertical load to the frame supporting the mockup specimen, so as to induce a deflection in the mockup equivalent to the live load deflection identified on the drawings at the location the mockup is simulating. The load shall be applied and released through ten (10) cycles. Visually inspect mockup specimen after each displacement.

i) Test 9 (Exterior Window Maintenance Equipment Test): Perform concentrated load testing on the exterior wall maintenance tie back equipment attached to the exterior wall framing. Apply outward, inward, and side-loading of a magnitude and for a duration as required to comply with the authorities having jurisdiction for window washing equipment. There shall be no failure or gross permanent distortion of the tie back equipment or any part of the exterior wall framing.

j) Test 10 (For Thermal Transmittance and Condensation Resistance): At the completion of Test 9, carefully disassemble the glass, glazing, and metal framing components and reassemble them as a mockup, and test the mockup, in accordance with AAMA 1503.1.

d. Corrective Measures: Correct deficiencies in mockups observed during testing and repeat tests as required to show compliance with performance standards. Deficiencies requiring repair or modification to mockup(s) require complete retesting of mockup(s) beginning with the specified Preliminary Test unless otherwise directed by the Architect.

1) The Owner will pay the cost of the first mock-up test. The cost of subsequent tests and retesting is the responsibility of the contractor. The Contractor shall bear costs for additional retesting until compliance with performance standards is accomplished.

2) Incorporate corrective measures indicated by the test report into the final exterior wall assemblies after review by the Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Identify components of curtainwall Work after fabrication by marks clearly indicating location in the building. Package components to protect components from damage during shipping and handling.

B. Storage on Site: Store units, components, and materials in clean, dry location, away from uncured concrete, masonry Work, sprayed on fireproofing Work, and construction activities. Cover with non-staining waterproof paper, tarpaulin, or polyethylene sheeting to permit circulation of air inside the covering.

C. Keep handling on site to a minimum. Exercise care to avoid damage to finishes of metals or breakage of glass.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so curtainwall Work is accurately designed, fabricated, and fitted to the structure. Indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating curtainwalls without field measurements. Coordinate supporting structure construction to ensure actual dimensions correspond to established dimensions.

1.9 WARRANTY

A. Assembly Warranty: Written warranty signed by manufacturer, Contractor, and Installer in which the manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.
      b. Structural failures including, but not limited to, excessive deflection.
      c. Glass breakage due to defective design.
      d. Noise or vibration created by wind and thermal and structural movements.
      e. Deterioration of metals, metal finishes, and materials beyond normal weathering.
      f. Water penetration through fixed glazing and framing areas.
      g. Deterioration of materials and finishes beyond normal weathering.
      h. Failure of insulating glass.
      i. Noise or vibration created by wind and thermal and structural movements.
      j. Failure of operating components.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FRAMING

A. Basis of Design Manufacturer/Product: Kawneer North America, 1600 Series or equivalent product from list of approved manufacturers. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

1. Arcadia, Inc.
2. Bruce Wall Systems Corporation.
3. CMI Architectural.
4. EFCO Corporation.
5. EXTECH/Exterior Technologies, Inc.
6. Oldcastle Building Enclosure.
7. Pittco Architectural Metals, Inc.
8. SAFTI FIRST Fire Rated Glazing Solutions.
9. Trulite Glass & Aluminum Solutions, LLC.
10. Tubelite Inc.
11. U.S. Aluminum; a brand of C.R. Laurence.
12. Unitized Systems LLC.
13. Waltek & Company Limited.
14. Wausau Window and Wall Systems; Apogee Wausau Group.
15. YKK AP America, Inc.

B. Framing Members: Extruded or formed aluminum framing members of thickness required and reinforced necessary to support imposed loads.
1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides and Retained mechanically with gaskets on two sides and structural sealant on two sides, as indicated on Drawings.
3. Glazing Plane: Front.
4. Finish: Reference Section 01 60 13 – Exterior Design Selections.
5. Fabrication Method: Factory fabricated unit and mullion system.

C. Aluminum Curtain Wall System: Kawneer Co., Inc., 1600 Series or equivalent product from list of approved manufacturers:
1. Structural Properties:
   a. Limit the dead load deflection of horizontal members supporting glass to 1/175 of the clear span with a 1/8-inch maximum deflection.
   b. Limit the deflection of any member in a direction parallel to the plane of the wall and of any corner mullion in both parallel and perpendicular directions to a maximum of 25 percent of the glass bite dimension and maintain a minimum of 1/8 inch clearance between the member and the edge of the glass, panel, or other component.
   c. Limit the wind load deflection of any member to 1/240 plus 1/4 inch of the clear span, based on "pinned" ends.
   d. Limit the wind load deflection of corner mullions to the span as specified above, with the specified pressure acting on one face of

the building with no pressure acting on the adjacent face, or 1/2 the specified pressure acting on one face of the building with 1/2 the specified suction acting on the adjacent face, whichever is the greatest.

e. No wall element shall sustain permanent deflection of glass breakage under maximum design load.

f. The panels and their connections shall accommodate movements of the structure resulting from lateral forces. Provide connections with sufficient ductility to preclude brittle failure, at or near, welds.

D. Framing Sizes: 2-1/2 inches x 7 ½ inches where indicated on the drawings. Miter ends of horizontals at exterior and interior corners.

E. Pressure Caps: Aluminum components that mechanically retain glazing with snap on aluminum trim that conceals fasteners.

F. Brackets and Reinforcements: High strength aluminum with non-staining, nonferrous shims for aligning system components.

G. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Zinc rich, corrosion resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot Rolled Sheet and Strip: ASTM A 1011/A 1011M.
3. Carbon Steel: ASTM A36.

H. Entrances: Comply with Section 08 41 13 – Aluminum Entrances and Storefronts.

2.2 GLAZING

A. Glazing: Comply with Section 08 80 00 - Glazing.

B. Glazing Gaskets: Sealed corner pressure glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: Recommended by manufacturer.

D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtainwall assembly indicated.

1. Color: Black.

E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural sealant, weatherseal sealant, and structural sealant glazed curtainwall manufacturers for this use.
   1. Color: Match structural sealant.

2.3 ACCESSORIES

A. Fasteners and Accessories: Corrosion resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Corrosion resistant, non-staining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold applied asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.4 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from exterior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
   7. Components curved to indicated radii.

D. Fabricate components to resist water penetration:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtainwall Framing: Fabricate components for assembly using shear block system.

F. Factory Assembled Frame Units:
1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 08 80 00.

G. After fabrication, clearly mark components to identify locations according to Shop Drawings.

2.5 ALUMINUM FINISHES

A. Baked Enamel or Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: Reference Section 01 60 13 – Exterior Design Selections.

2.6 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, adjoining construction, structural support, anchorage, and conditions, with installer present, for compliance with requirements for installation tolerances and conditions affecting performance of the Work.
1. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and built-in components to ensure weathertight window wall installation.
2. Notify Architect in writing, of dimensions, or conditions, found which prevent proper execution of the window wall Work, including specified tolerances.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. Coordinate installation with building enclosure Work.

B. Comply with manufacturer's written instructions for installing curtain wall, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
   1. Do not install damaged components.
   2. Fit frame joints to produce hairline joints free of burrs and distortion.
   3. Rigidly secure nonmovement joints.
   4. Remove loose particles present or resulting from fabrication or field cutting and drilling by blowing out joints with oil free compressed air, or by vacuuming joints.
   5. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue.
   6. Do not allow solvent to air dry without wiping. Use lint free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) or xylene unless otherwise required by compatibility and adhesion testing results. Seal joints watertight. Clean excess joint sealants from finished surfaces.
   7. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   8. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
   9. Seal joints watertight unless otherwise indicated.
   10. Set components within erection tolerances with uniform joints. Place components on shims and fasten to supporting substrates using bolts and similar fasteners.
   11. Do not erect components that are warped, deformed, bowed, dented, defaced, or damaged and impair strength or appearance. Remove and replace members damaged in process of erection.
   12. Coat concealed surfaces of dissimilar materials, and ferrous metal components, with heavy coating of bituminous paint, zinc rich primer or separation in accordance with manufacturer's recommendations. Where aluminum components will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
   13. Do not burn, cut into or field drill holes or slots in building framing member without written acceptance of the structural engineer.

C. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Install components plumb and true in alignment with established lines and grades.

F. Permanently fasten to building structure with manufacturer recommended attachments and shims to permanently fasten system to building structure. Securely anchor components and units in place, allowing for required movement, including expansion and contraction. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weathertight construction.

G. Water Drainage: Compartmentalize each light of glass using joint plugs and silicone sealant to divert water to the horizontal weep locations. Locate weep holes in the horizontal pressure plates and covers to divert water to the exterior of the building.

H. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather stripping contact and hardware movement to produce proper operation.

I. Glazing: Install glazing gaskets and sealants in accordance with manufacturer's instructions without exception; including surface preparations. Refer to Section 088000.
1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

J. Insulation and Fire Stopping: Refer to Section 07 21 00 and Section 07 84 00, respectively.

K. Weatherseal: Install weatherseal sealant according to Section 079200 and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).

c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.
5. Tolerances are not accumulative.

3.5 FIELD QUALITY CONTROL

A. The Owner will engage an independent testing and inspection agency to verify the adequacy of the Contractor's quality control. Obtain inspections from representative of the Owner's independent testing and inspection agency. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
   a. Perform a minimum of two tests in areas as directed by Architect.
2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
   a. Perform a minimum of two tests in areas as directed by Architect.
3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing, but not less than 6.24 lbf/sq. ft. (300 Pa) and shall not evidence water penetration.

D. Structural Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, Hand Pull Tab (Destructive), Appendix X2.
1. Test a minimum of two areas on each building facade.
2. Repair installation areas damaged by testing.

E. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. Remove and replace noncomplying windows and retest as specified.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional Work with specified requirements.

3.6 CLEANING

A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.

B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.

C. Immediately remove deleterious material from surfaces of aluminum.

3.7 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that window wall Work will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08 44 13

SECTION 08 71 00 DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
      10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Final approved hardware schedule edited to reflect conditions as installed.
   d. Final keying schedule
   e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation ofelectrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.

   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door

hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

a. Mechanical Warranty
   1) Extra Heavy Duty Cylindrical Locks: 10 years
   2) Exit Devices: 3 years
   3) Closers: 30 years
b. Electrical Warranty: 1 year

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

D. The below listed manufactures are considered acceptable provided written authorization from Tomball ISD has been secured and is presented with submittal for validation.

ITEM:	MANUFACTURER:	ACCEPTABLE SUB:
Hinges	(IVE) Ives	Hager, McKinney
Key System	(SCH) Schlage	No Substitution
Locks	(SCH) Schlage	No Substitution
Exit Devices	(VON) Von Duprin	No Substitution
Closers	(LCN) LCN	No Substitution
Auto Flush Bolts	(IVE) Ives	DCI, Rockwood
Coordinators	(IVE) Ives	Hager, Rockwood
Silencers	(IVE) Ives	Hager, Rockwood
Push & Pull Plates	(IVE) Ives	Hager, Rockwood
Vandal Resistant Trim	(IVE) Ives	Owner’s Standard
Kickplates	(IVE) Ives	Hager, Rockwood
Stops & Holders	(IVE) Ives	Hager, Rockwood
Overhead Stops	(GLY) Glynn-Johnson	ABH
Thresholds	(ZER) Zero Int.	NGP, Pemko
Seals & Bottoms	(ZER) Zero Int.	NGP, Pemko
Key Cabinets	(LUN) Lund	TelKee

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.

3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.

7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 CYLINDRICAL LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage ND series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
   b. Lever Design: Schlage Sparta (SPA)

9. Specific room functions:
   a. Teacher, Staff and Adult single restrooms - ND40
   b. Classroom and Teacher Lounge doors – ND70
   c. Single user student restrooms off classrooms (eg. Kindergarten and Pre-K), Adult uni-sex restroom ahead of security vestibule at entrance only, clinic student restrooms, staff restroom inside kitchen area, staff restroom inside custodial restroom – ND40
   d. Communicating Classroom Doors – ND82

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 99 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.09 Keying Requirements

A. Key System: Schlage Primus XP utility-patented keyway on exterior doors only, conventional cylinders. Utility patent protection to extend at least until 2039. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers. For estimate use factory GMK charge. Initiate and conduct meetings(s) with Owner and I-R Security & Safety Consultants representatives to determine system key-way(s) and structure. Furnish Owner’s written approval of the system.

1. Existing factory registered master key system.
2. Stamp all keys, cylinder plugs and core face with keyset symbol “VKC”

3. Supply 2 cut keys per cylinder
4. Supply 2 cut master keys for each master and grand master used in project.
5. Supply 100 key blanks.
6. Supply 500 electronic key fobs the design of which is specified by owner
7. Non-I.C. construction keying: furnish Split-key. At substantial completion, remove inserts in Owner's presence; demonstrate consequent non-operability of construction key. Give all removed inserts and all construction keys to Owner.
8. Furnish 10 construction keys.
9. Furnish 2 construction insert extractor tool 35-057.
10. Furnish 2 construction control keys.
11. Furnish (2) key cabinets and (2) tag filing systems, size of boxes to be determined by owner
12. Furnish 2 Grand Master Primus XP control keys
13. Furnish 20 P&S locking keys for light switches
14. All keys must be turned over to the District Locksmith with a transmittal sheet

B. At Substantial Completion, Contractor to remove inserts in Owner's presence and demonstrate consequent non-operability of construction key. Contractor to give all removed inserts and all construction keys to Owner. Owner's Disstrict locksmith will install permanent cylinders.

C. Bitting List: furnish secured shipment direct from point of origination to Owner's Director of Maintenance upon completion. Locksmith will set up key box; Contractor to hang key box in location(s) determined by Owner.

D. Initiate and conduct keying meeting(s) with Owner and I-R Security & Safety Consultants representatives to determine system keyway(s) and structure. Furnish Owner's written approval of the system

E. Key Cylinders: furnish conventional 6-pin solid brass construction by same manufacturer. New Construction shall all be FSIC removable core format for all interior locksets.

F. Furnish Schlage Primus XP interchangeable core cylinders for all exterior exit devices. Interior exit devices and mullions shall be non-Primus cores.

G. Cylinders/Cylinder cores: furnish keyed at factory of lock manufacturer where permanent records are maintained. Locks and cylinders same manufacturer and secure shipment direct to owner.

H. Permanent keys: furnish secured shipment direct from point of origination to Owner.

2.10 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4040XP series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Heavy Duty arms (EDA) at exterior doors scheduled with parallel arm units.
12. All closers to be through bolted.
13. All teacher lounges to receive closer.
14. All exterior closers to be supplied with Cush Arms

2.11 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.12 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.14 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.16 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.17 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION
3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.

4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

HARDWARE SETS:

154521 OPT0427812 Version 4
Hardware Group No. 001-EXT - OVERHEAD DOOR / MANUAL (EXTERIOR)
PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	FSIC MORTISE CYLINDER	20-061 ICX W/CONST. CORE QTY/TYPE REQD/COORD W/MFG	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
	EA	HARDWARE	REMAINDER OF HARDWARE BY DOOR MFG	FBO	UNK

COORDINATE LOCKING REQUIREMENTS WITH DOOR MANUFACTURER.

Hardware Group No. 001-INT - OVERHEAD DOOR / MANUAL (INTERIOR)
PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	FSIC MORTISE CYLINDER	20-061 ICX W/CONST. CORE QTY/TYPE REQD/COORD W/MFG	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC QTY/TYPE REQD/COORD W/MFG	626	SCH
	EA	HARDWARE	REMAINDER OF HARDWARE BY DOOR MFG	FBO	UNK

COORDINATE LOCKING REQUIREMENTS WITH DOOR MANUFACTURER.

Hardware Group No. 201 - SGL STORAGE LOCK/CLSR
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA K510-066	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 201-MEZ - SGL STORAGE LOCK/CLSR
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA K510-066	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

DOOR NOT LOCATED - PROVIDE CLOSER ARM/MOUNTING AS REQUIRED, AND DOOR SEALS/THRESH IF EXTERIOR?

Hardware Group No. 203 - SGL STORAGE LOCK
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP (OUTSWING)	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA K510-066	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC	626	SCH
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 301G - SGL PRIVACY/CLSR/488S-SEAL (TYP CORR/STF) NO INDICATOR????
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	652	IVE
1	EA	PRIVACY LOCK	ND40S SPA K510-066	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER

Hardware Group No. 501 - SGL CLASSROOM LOCK/CLSR - STAFF/WORK AREA, WKRM, LOUNGE, CONNECT-CLSSRMS
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	652	IVE
1	EA	CLASSROOM LOCK	ND70TD SPA K510-066	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 801LG - SGL PUSH/PULL/CLSR/DEADLOCK (MULTI-STALL RESTROOM) 488 GASKET
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	652	IVE
1	EA	CLASSROOM DEADBOLT	B663T	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC	626	SCH
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER

Hardware Group No. C205 - SGL EXTERIOR STORAGE LOCK (ACCESS CONTROLLED) PUMP,MECH, RISER

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELECTRIFIED LOCK (FAIL SECURE)	ND80TDEU SPA K510-066 RX CON 12V/24V DC	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH SRI TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	GASKETING SET	328AA-S H & J	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226 FRAME WIDTH	A	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	MULTITECH READER	MT11/MT15 AS REQ (BY DIV 28 13 00)	BLK	SCE
1	EA	DOOR CONTACT	679-05 AS REQ (BY DIVISION 28 13 00)	WHT	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS (BY DIVISION 28 13 00)	LGR	SCE

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

Hardware Group No. C205I - SGL EXTERIOR/INSWNG STORAGE LOCK (ACCESS CONTROLLED) PUMP,MECH, RISER
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELECTRIFIED LOCK (FAIL SECURE)	ND80TDEU SPA K510-066 RX CON 12V/24V DC	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA SRI TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	GASKETING SET	328AA-S H & J	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	655A-EV3-226 FRAME WIDTH	A	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	MULTITECH READER	MT11/MT15 AS REQ (BY DIV 28 13 00)	BLK	SCE
1	EA	DOOR CONTACT	679-05 AS REQ (BY DIVISION 28 13 00)	WHT	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS (BY DIVISION 28 13 00)	LGR	SCE

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

Hardware Group No. C214 - PAIR EXTERIOR STORAGE LOCK (ACCESS CONTROLLED) PUMP,MECH,RISER,MEZZ
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
2	EA	MANUAL FLUSH BOLT	FB458-12"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	ELECTRIFIED LOCK (FAIL SECURE)	ND80TDEU SPA K510-066 RX CON 12V/24V DC	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH SRI TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
2	SET	GASKETING SET	328AA-S H & J	AA	ZER
1	EA	OVERLAPPING ASTRAGAL	383AA-DOOR HEIGHT (OR AS REQD BY DR MFG)	AA	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226 FRAME WIDTH	A	ZER
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	MULTITECH READER	MT11/MT15 AS REQ (BY DIV 28 13 00)	BLK	SCE
2	EA	DOOR CONTACT	679-05 AS REQ (BY DIVISION 28 13 00)	WHT	SCE
1	EA	POWER SUPPLY	PS904 BBK 900-4RL (BY DIVISION 28 13 00)	LGR	SCE

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

Hardware Group No. C714M - PAIR EXTER PANIC (HM) (ACCESS CONTROLLED) 2-RX-QEL/99-VR/KR4954/DC
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	630	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
2	EA	ELEC PANIC HARDWARE	RX-QEL-99-EO-CON 24 VDC	626	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
1	EA	FSIC RIM CYLINDER	20-057 ICX W/CONST. CORE	626	SCH
1	EA	FSIC MORTISE CYLINDER	20-061 ICX W/CONST. CORE	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
1	EA	FSIC PERMANENT CORE	23-030-VKC	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH SRI TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	MULLION SEAL	139N PSA HEIGHT AS REQ		ZER
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
2	SET	GASKETING SET	328AA-S H & J	AA	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	655A-EV3-226 FRAME WIDTH	A	ZER
2	EA	VIEWER	698 (WHERE APPLICABLE/FLUSH DR)	626	IVE
2	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
2	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	MULTITECH READER	MT11/MT15 AS REQ (BY DIV 28 13 00)	BLK	SCE
2	EA	DOOR CONTACT	679-05 AS REQ (BY DIVISION 28 13 00)	WHT	SCE
1	EA	POWER SUPPLY	PS904 BBK 900-4RL (BY DIVISION 28 13 00)	LGR	SCE

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

Hardware Group No. C715 - SGL EXTER PANIC (HM) (ACCESS CONTROLLED) RX-QEL/99-VR/VIEWR/DC
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-EO-CON	626	VON
1	EA	FSIC RIM CYLINDER	20-057 ICX W/CONST. CORE	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH SRI TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	GASKETING SET	328AA-S H & J	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	655A-EV3-226 FRAME WIDTH	A	ZER
2	EA	VIEWER	698 (WHERE APPLICABLE/FLUSH DR)	626	IVE
1	EA	HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W (CONNECTION LEADS)		SCH
1	EA	MULTITECH READER	MT11/MT15 (BY DIVISION 28 13 00)	BLK	SCE
1	EA	DOOR CONTACT	679-05 AS REQ (BY DIVISION 28 13 00)	WHT	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS (BY DIVISION 28 13 00)	LGR	SCE

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

Hardware Group No. D214 - PAIR EXTERIOR STORAGE LOCK (DR CONTACT)
PUMP,MECH,RISER,MEZZ
PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP (OUTSWING)	630	IVE
2	EA	MANUAL FLUSH BOLT	FB458-LENGTH AS REQ	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80TD SPA K510-066	626	SCH
1	EA	FSIC PERMANENT CORE (EXT CORE)	20-740-XP-VKC	626	SCH
2	EA	SURFACE CLOSER	4040XP RW/PA SRI TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
2	EA	DOOR STOP	FS448/ WS401CCV AS REQ	626	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	SET	GASKETING SET	328AA-S H & J	AA	ZER
1	EA	OVERLAPPING ASTRAGAL	383AA-DOOR HEIGHT (OR AS REQD BY DR MFG)	AA	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	655A-EV3-226 FRAME WIDTH	A	ZER
2	EA	DOOR CONTACT	679-05 AS REQ (BY DIVISION 28 13 00)	WHT	SCE

END OF SECTION

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 13 – Exterior Design Selections.

C. Section 08 41 13 – Aluminum Framed Entrance and Storefront.

D. Section 08 44 13 – Glazed Aluminum Curtain Walls.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Float glass.
2. Tempered glass.
3. Insulated glass.
4. Laminate glass.
5. Glazing sealants.
6. Glass film overlay.
7. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

B. Interspace: Space between lites of an insulating glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.

B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
a. Wind Design Data: As indicated on Drawings.

b. Basic Wind Speed: As indicated on Drawings.
c. Importance Factor: As indicated on Drawings.

2. Exposure Category: As indicated on Drawings.
3. Design Snow Loads: As indicated on Drawings.
4. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
5. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.

D. Windborne Debris Impact Resistance: Exterior glazing shall comply with [basic] [enhanced]-protection testing requirements in ASTM E 1996 for [Wind Zone 3] when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
1. Large Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small Missile Test: For glazing located more than 30 feet (9.1 m) above grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
2. For laminated glass lites, properties are based on products of construction indicated.
3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.5 SUBMITTALS

A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.

B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.

C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.

D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Product Certificates: Submit glass product certificates required by Code.
1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.

F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.

2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.

G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements of the IBC for glazing.
2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission *Safety Standard for Architectural Glazing Materials*, published in the Code of Federal Regulations) and ANSI Z97.1.
b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.

3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
4. Glazing Publications: Comply with published recommendations of glass product organizations.
a. GANA: Glazing Manual.

b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
c. GANA: Laminated Glazing Reference Manual.
d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
e. AAMA: TIR A7 Sloped Glazing Guidelines.
f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.

5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
   a. Minimum Glass Thickness for Exterior Lites: 1/4 inch (6 mm).
   b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.

7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
   a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
   b. Where fully tempered float glass is indicated, provide fully tempered float glass.

B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.

C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.

D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.

E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.

F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

I. Install glazing in mockups indicated in Drawings to match glazing systems required for Project, including glazing methods.
   1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

J. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

K. Preinstallation Conference: Conduct conference at site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.

D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.

E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).

B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.10 WARRANTY

A. Written warranty, executed by glass manufacturer agreeing to repair or replace glass units that fail in materials and workmanship or deteriorate within warranty period. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to decorative glass manufacturer's published instructions.
1. Warranty Period: Five (5) years from date of Substantial Completion.

B. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

C. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

D. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

E. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor, change appearance, or failure to meet solar criteria within specified warranty period.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Glass:
      a. AGC Glass Company North America, Inc.
      b. Guardian Industries Corp.; SunGuard.
      c. Oldcastle Building Envelope.
      d. Pilkington North America.
      e. Viracon.
      f. Vitro Architectural Glass.

   2. Fire Protection Rated Glazing:
      a. McCrory Glass, Inc.
      b. SAFTI FIRST Fire Rated Glazing Solutions.
      c. Technical Glass Products.

   3. Glass Film:
      a. 3M Construction Markets Division. http://www.3m.com
      b. Bekaert Specialty Films. http://www.solargard.com
      c. Madico.http://www.madico.com

B. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

C. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3.

D. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.

E. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

F. Heat Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

G. Pyrolytic Coated, Low Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

H. Ceramic Coated Vision Glass: ASTM C 1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA Engineering Standards Manual.

I. Reflective Coated Vision Glass: ASTM C 1376.

J. Ceramic Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one surface ceramic coated), Type I (transparent glass, flat), Quality q3 (glazing select), Class 1 (clear), with ceramic coating applied to second surface and complying with the following requirements:
   1. Class 1 (clear).
   2. Class 2 (tinted, heat absorbing, and light reducing).
      a. Tint Color: Solargray.
      b. Kind HS (heat strengthened); Kind FT (fully tempered).
      c. Coating Location: Second surface.
      d. Ceramic Coating Color: Selected by Architect from manufacturer's full range.

K. Adhered Backing: Adhered scrim backing to ceramic coated surface; provide backed units identical to materials which, while possibly developing cracks and fissures, show no shear nor develop any openings large enough for the unobstructed penetration of 3-inch diameter sphere when tested by approved independent testing laboratory:
   1. Mount test specimens consisting of 3 glass assemblies, 34" x 76" (plus zero or minus 3/16 inch), for testing as specified in ANSI Z-97.1.
   2. Expose specimens to 100 cycles of the following conditions:
      a. 1 hour at 0 degrees F, ambient humidity.
      b. 3 hours increase from 0 degrees F to 140 degrees F, 95 to 100 percent relative humidity.
      c. 1 hour at 140 degrees F, 95 to 100 percent relative humidity.
      d. 3 hours decrease from 140 degrees F to 0 degrees F, ambient humidity.
   3. Break glass by spring-loaded prick punch at midpoint of either vertical edge.
   4. After breaking glass, subject it to pressure of 4 lbf per sq. ft. for 5 minutes to simulate wind load.
   5. Inorganic Opacifier: Provide polyethylene opacifier where no insulation and other backing material is applied directly to spandrel glass. Use polyester where direct attachment does occur.
   6. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C 1048.

L. Silicone Coated Spandrel Glass: ASTM C 1048, Type I, Condition C, Quality-Q3.

M. Reflective Coated Spandrel Glass: ASTM C 1376, Kind CS.

2.2 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Thickness: 0.060 inch (1.52 mm).
   4. Interlayer Color: Clear unless otherwise indicated.

B. Glass guards must be able to withstand a uniform load of 50 lbs/ft or a concentrated load of 200 lbs placed at the top of the handrail or guard.

2.3 INSULATING GLASS

A. Insulating Glass Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

B. Performance Properties:
1. Basis of Design Product: Reference Section 01 60 13 – Exterior Design Selections.

C. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum.
2. Manufacturers: Subject to compliance with requirements, provide products by Technoform Glass Insulation NA, Inc.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.4 GLAZING ACCESSORIES

A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.

B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

C. Colors of Exposed Glazing Sealants: Selected by Architect from manufacturer's full line of color selections.

D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. May National Associates, Inc.; a subsidiary of Sika Corporation.
   d. Pecora Corporation.
   e. Sika Corporation.

E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BASF Corporation; Construction Systems.
   b. Dow Corning Corporation.
   c. GE Construction Sealants; Momentive Performance Materials Inc.
   d. May National Associates, Inc.; a subsidiary of Sika Corporation.
   e. Pecora Corporation.

f. Polymeric Systems, Inc.
g. Sika Corporation.

F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bostik, Inc.
b. Dow Corning Corporation.
c. GE Construction Sealants; Momentive Performance Materials Inc.
d. May National Associates, Inc.; a subsidiary of Sika Corporation.
e. Polymeric Systems, Inc.
f. Schnee-Morehead, Inc., an ITW company.
g. Sika Corporation.

G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. BASF Corporation; Construction Systems.
b. Bostik, Inc.
c. Dow Corning Corporation.
d. GE Construction Sealants; Momentive Performance Materials Inc.
e. May National Associates, Inc.; a subsidiary of Sika Corporation.
f. Pecora Corporation.
g. Polymeric Systems, Inc.
h. Schnee-Morehead, Inc., an ITW company.
i. Sika Corporation.

H. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; non-staining and nonmigrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

I. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. 2 AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

J. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
5. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
6. Perimeter Insulation for Fire Resistive Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.5 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
   1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
      a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

   2. Edge and Surface Conditions: Comply with the recommendations of AAMA *Structural Properties of Glass* for clean cut edges, except comply with manufacturer's recommendations.
   3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.

B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.

C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
   1. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.

2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.

B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.

C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.

E. Glass Film Preparation:
1. Remove particulate matter on the glass surface using a scraping blade.
2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

3.3 GLAZING

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
   1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
   1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
   2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
   3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
   4. Do not remove release paper from tape until right before each glazing unit is installed.
   5. Apply heel bead of elastomeric sealant.
   6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
   7. Apply cap bead of elastomeric sealant over exposed edge of tape.

L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
   1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
4. Install gaskets to protrude past face of glazing stops.

M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.
3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.

O. Glass Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
1. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.5 mm) to 1/32 inch (0.75 mm) of the window sealing device. Avoid scoring glass when cutting film.

2. Clean film and leave free of soap residue and squeegee marks.

P. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
4. Maximum Joint Gap: 1/32 inch.

3.4 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 - SCHEDULE

4.1 GLAZING SCHEDULE

GL-1 **Clear Insulated Vision Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) clear tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite.

GL-2 **Clear Insulated Spandrel Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) clear tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite with Charcoal Gray Opaci-Coat (#4).

GL-3 **Gray Insulated Vision Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) Gray tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite.

GL-4 **Red Insulated Vision Glass:** 1-1/16 inch (25 mm) sealed insulated unit consisting of an exterior lite of 3/16 inch (5 mm) clear tempered float glass, .090 PVB Vanceva Interlayer (Color: 0C1C), 3/16 inch (5mm) clear tempered float glass, 3/8 inch (8mm) air space, and ¼ inch (6mm) SunGuard SNX 60+ low-e (#5) clear tempered float glass interior lite.

GL-5 **Gray Insulated Spandrel Glass:** 1 inch (25 mm) sealed insulated unit consisting of an exterior lite of 1/4 inch (6 mm) SunGuard SNX 60+ low-e (#2) gray tempered float glass, 1/2 inch gas filled air space, and 1/4 inch (6 mm) clear tempered float glass interior lite with Charcoal Gray Opaci-Coat (#4).

GL-6 **Red Insulated Spandrel Glass:** 1-1/16 inch (25 mm) sealed insulated unit consisting of an exterior lite of 3/16 inch (5 mm) clear tempered float glass, .090 PVB Vanceva Interlayer (Color: 0C1C), 3/16 inch (5mm) clear tempered float glass, 3/8 inch (8mm) air space, and ¼ inch (6mm) SunGuard SNX 60+ low-e (#5) clear tempered float glass interior lite with Charcoal Gray Opaci-Coat (#6).

END OF SECTION 08 80 00

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 83 00 – MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections.

C. Section 08 80 00 – Glazing.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Glass mirrors.
   2. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Deterioration of Mirrors: Defects developed from normal use attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to mirror manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1.4 PERFORMANCE REQUIREMENTS

A. Provide mirrors that will not fail under normal usage. Failure includes glass breakage and deterioration attributable to defective manufacture, fabrication, and installation.

1.5 SUBMITTALS

A. Product Data: Technical data for mirror units including description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality control provisions.

B. Shop Drawings: Submit mirror elevations, edge details, mirror hardware, and attachments to other Work.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.
   2. Glazing Publications: Comply with published recommendations:

a. GANA *Glazing Manual* unless more stringent requirements are indicated.
b. GANA Mirror Division Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors.

3. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

B. Installer Qualifications: Experienced installer having minimum 5 years documented experience and has completed mirror glazing similar in material, design, and extent to that indicated.

C. Source Limitations for Mirrors: Obtain mirrors from one source for each type of mirror indicated.

D. Source Limitations for Mirror Glazing Accessories: Obtain mirror glazing accessories from one source for each type of accessory indicated.

E. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing and substrates on which mirrors are installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and necessary to prevent damage to mirrors from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

A. Warranty: Warranty made out to Owner and signed by mirror manufacturer agreeing to replace mirrors that deteriorate, f.o.b. the nearest shipping point to site, within specified warranty period:
1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide mirrors by one of the following:
1. Guardian Industries Corp.
2. Trulite Glass & Aluminum Solutions.
3. Virginia Mirror Company, Inc.

4. VVP America, Inc.; Binswanger Mirror Products.
5. Walker Glass Co., Ltd.

B. Clear Glass Mirrors: Annealed monolithic glass, ASTM C 1503, Mirror Select Quality, clear float glass with a minimum 91 percent visible light transmission.
1. Nominal Thickness: 6.0 mm.

C. Setting Blocks: Elastomeric material with Type A Shore durometer hardness of 85, plus or minus 5.

D. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

E. Mirror Mastic: Adhesive setting compound, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed. Provide product recommended by mirror manufacturer.

F. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 inch and 7/8 inch (9.5 mm and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
a. Products: Subject to compliance with requirements, provide one of the following:
1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
2) Sommer & Maca Industries, Inc.; Aluminum Shallow Nose "J" Moulding Lower Bar.
2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
a. Products: Subject to compliance with requirements, provide one of the following:
1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
2) Sommer & Maca Industries, Inc.; Aluminum Deep Nose "J" Moulding Upper Bar.
3. Finish: Clear anodized.

G. Top and Bottom Clips: As indicated.

H. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

I. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead shield expansion bolt devices for drilled in place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.2 FABRICATION

A. Mirror Sizes: To suit conditions, cut mirrors to final sizes and shapes.

B. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.

C. Mirror Edge Treatment:
1. Cutting and Polishing: Flat edges where the clean cut square edge of the glass is flat and surface edges are slightly arrissed. After grinding the arisses, polish edges to a high gloss surface where the surface reflectivity is similar in appearance to the major surface of the glass.
2. Edge Sealing: Immediately after cutting to final sizes, and applying edge treatment, factory seal edges of mirrors with edge sealer to prevent chemical or atmospheric penetration of glass coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted for compliance with installation tolerances, substrate preparation, and conditions affecting performance. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers. Proceed with mirror installation after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating surfaces with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images. Provide minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

B. Wall Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
1. For metal clips, place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges.
2. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips to be symmetrically placed and evenly spaced.
a. Fabricate bottom trim in single lengths to fit and cover bottom edges of mirrors. Locate top clips so they are symmetrically placed and evenly spaced.

4. Mastic: Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
   a. Apply mastic in vertical beads or mounds to the wall, not to the mirror back to avoid potential damage caused by mastic applicator tools, in compliance with mastic manufacturer's written instructions to allow air circulation between back of mirrors and face of mounting surface.
   b. Make each vertical bead approximately 1/2 inch in width with minimum of one bead for every square foot of mirror.
   c. Make each mound approximately 1-1/2 inch in diameter with a minimum of one mound for every square foot of mirror.
   d. Do not apply mastic within 6 inches of the mirror edges to prevent squeeze out. Place beads or mounds leaving a space between mirror and wall. After mastic is applied, align mirrors and press into place. Spread each vertical bead to approximately 2 inches in width and spread each mound to a pat approximately 3-1/2 inch in diameter after pressing mirror into place.
   e. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations. Do not permit edges of mirrors to be exposed to standing water. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

B. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 83 00

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 92 00 – FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Extruded aluminum horizontal screens.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).

D. Drainable Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind Driven Rain Resistant Louver: Louver that provides specified wind driven rain performance determined by testing according to AMCA 500-L.

1.4 SUBMITTALS

A. Product Data: Technical data for each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For screens and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show frame profiles and blade profiles, angles, and spacing.
   1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
   2. Show mullion profiles and locations.
   3. Windstorm: Design loads as indicated on drawings.

C. Samples: Submit for units with factory applied color finishes.

1.5 QUALITY ASSURANCE

A. Delegated Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

C. Wind Loads: Determine loads based on pressures as indicated on Drawings.

D. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 m) of grade shall pass basic protection, large-missile testing requirements in ASTM E 1996 for Wind Zone 3 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than louvers indicated for use on Project.

E. Regulatory Requirements:
1. SMACNA Standard: Comply with recommendations in SMACNA *Architectural Sheet Metal Manual* for fabrication, construction details, and installation procedures.
2. Welding: Qualify procedures and personnel according to the following:
a. AWS D1.2/D1.2M Structural Welding Code - Aluminum.

F. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory applied color finish.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum screens by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum screens that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Water leakage through fixed glazing and framing areas.
d. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.

D. Stainless Steel Sheet: ASTM A 240/A 240M, Type 304, No. 4 finish, with grain running parallel to length of blades and frame members..

E. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use tamper resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

3. For fastening galvanized steel, use hot dip galvanized steel or 300 series stainless steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color finished louvers, use fasteners with heads that match color of louvers.

F. Postinstalled Fasteners for Concrete and Masonry: Torque controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Airolite Company, LLC (The).
2. Ametco.
3. Arrow United Industries.
4. Construction Specialties, Inc.
5. Greenheck Fan Corporation.
6. Ruskin Company; Tomkins PLC.

B. Extruded aluminum horizontal louvered enclosure: Basis of Design Ruskin Company Model ELF6375DX/ ELF6375DXH.
a. Style: Horizontal.
b. Frame and Blade Nominal Thickness: Not less than 0.081 inch (2.1 mm).
c. Screen: 3/4” x .051” (19 x 1.3) expanded, flattened aluminum bird screen in removable frame.
d. Finish: Mill.
e. Minimum Size: 12 inches by 12 inches.
f. Free Area: 57%.
g. Beginning point of water penetration at .01 oz./sq.ft. is 1023 fpm (312 m/min).
h. All welded construction.
1. Accessories
a. Corners: Mitered.
b. Access Sections: Hinged.

2.3 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field bolted assembly with close fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade spacing pattern unless horizontal mullions are indicated.
2. Horizontal Mullions: Visible horizontal mullions not permitted.
3. Vertical Mullions: Visible vertical mullions not permitted.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill to produce uniform appearance.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
   1. Fully Recessed Mullions: provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close fitting blade splices designed to permit expansion and contraction.
   2. Exterior Corners: Prefabricated corner units with mitered blades with concealed close fitting splices and with fully recessed mullions at corners.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.4 FINSHES

A. Comply with NAAMM *Metal Finishes Manual for Architectural and Metal Products* for recommendations for applying and designating finishes.

B. Aluminum Finishes:
   1. Finish louvers after assembly.
   2. High Performance Organic Finish: Two coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Color and Gloss:
         1) Custom color two coat mica selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent Work.

B. Use concealed anchorages.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective Work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective Work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
   1. Touch up minor abrasions in finishes with air dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.

END OF SECTION 08 92 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Gypsum Board.
2. Partition Framing Systems.
3. Exterior Gypsum Board for Ceilings and Soffits.
4. Reinforced Gypsum Board Sheathing (Tile Backer Board).
5. Cementitious Backer Units.
6. Ceiling Suspension Systems.
7. Accessories necessary for a complete installation.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
2. Ground Floor Lobbies: 1/120 at 15 psf.
3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
5. Typical Partitions: 1/240 at 5 psf.
6. Other Partitions: 1/240 at 5 psf.
    a. Maximum Deflection:
        1) L/240 at 5 lbf per sq. ft.
        2) L/120 at 5 lbf per sq. ft.
        3) L/120 at 7.5 lbf per sq. ft.
        4) L/120 at 10 lbf per sq. ft.

B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.4 SUBMITTALS

A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer’s load tables.
1. Sustainable Design Submittals:
    a. Product Data: For recycled content, indicating post-consumer and pre-consumer recycled content.
    b. Product Data: For adhesives, indicating VOC content.

c. Laboratory Certificates or Validations: For adhesives, indicating compliance with requirements for low-emitting materials.
d. Certified Wood: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.

B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
1. Submit joint layout. Determine any anticipated areas of cracking or diminished resistance of cracking.

C. Samples:
1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for Work.

D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.

E. Evaluation Reports: ICC-ES reports for steel studs and runners and firestop tracks.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with applicable requirements of IBC for interior finishes.
2. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. Single Source Responsibility:
1. Framing Members: Obtain steel framing members from single manufacturer.
2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.

B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

D. Do not install panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 WARRANTY

A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. In addition, provide warranty from the manufacturer for the following products:
1. Exterior sheathing weathering warranty covering in-place exposure damage to exterior sheathing for twelve (12) months.
2. Exterior sheathing warranty against manufacturing defects for five (5) years.
3. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six (6) months.
4. Abuse Resistant Panel warranty against manufacturing defects for three (3) years.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Listed manufactures whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Steel Studs and Tracks:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) ClarkDietrich; (888) 437-3244.
2) CEMCO; California Expanded Metal Products Co.; (800) 775-2362.
3) MBA Building Supplies; (888) 248-8076.
4) Mill Steel Framing; (800) 247-6455.
5) MRI Steel Framing, LLC.; (630) 616-1850.
6) Phillips Manufacturing Co.; (800) 822-5055.
7) Steel Network, Inc. (The); (888) 474-4876.
8) Telling Industries; (866) 372-6384.

2. Ceiling Grid:
a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; 640-C.
c. CertainTeed Corporation.
d. USG Corporation; Drywall Suspension System.

3. Gypsum Board:
   a. Certainteed Corporation.
   b. Georgia Pacific.
   c. National Gypsum Company.
   d. USG Corporation.

4. Tile Backer Board:
   a. Gold Bond eXP; National Gypsum.
   b. Securock; United States Gypsum Company.

5. Cementitious Board:
   a. Durock Brand Cement Board; United States Gypsum Company.
   b. National Gypsum.

B. Framing Members: ASTM C 754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
   1. Steel Sheet Components: Comply with AISI S220 requirements for metal.
   2. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot dip galvanized.

C. Steel Framing Components: ASTM C 754 for conditions indicated; hot dip galvanize complying with ASTM A 653M Z180.
   1. Steel Studs and Runners: AISI S220, 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
   2. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
   3. Cold Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
   4. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
   5. Hat Shaped, Rigid Furring Channels: ASTM C 645; 0.0179 inch (0.45 mm) minimum base metal thickness; Depth indicated on Drawings.
   6. Resilient Furring Channels: 1/2 inch (12.7mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
   7. Cold Rolled Furring Channels: 0.0538 inch (1.37mm) bare steel thickness, with minimum 1/2 inch (12.7mm) wide flanges.
      a. Depth: Indicated on Drawings.
      b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
      c. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59mm) diameter wire, or double strand of 0.0475 inch (1.21mm) diameter wire.
   8. Z Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
   9. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
   10. Slip Type Head Joints: Where indicated, provide one of the following:
      a. Single Long Leg Runner System: ASTM C 645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
      b. Double Runner System: ASTM C 645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
   1) ClarkDietrich; MaxTrak Slotted Deflection Track.
   2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
   3) Superior Metal Trim; Superior Flex Track System (SFT).

11. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
    a. ClarkDietrich; BlazeFrame Fire Stop Deflection.
    b. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    c. Grace Construction Products; FlameSafe FlowTrak System.
    d. Metal-Lite, Inc.; The System.
    e. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series as applicable.

D. Ceiling Suspension Components:
   1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire.
   2. Hanger Attachments to Concrete:
      a. Anchors: Postinstalled, chemical anchor or postinstalled, expansion anchor fabricated from corrosion resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
      b. Powder Actuated Fasteners: Suitable for application indicated, fabricated from corrosion resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

   3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
   4. Carrying Channels: Cold rolled, commercial steel sheet with base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
   5. Furring Channels (Furring Members):
      a. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
      b. Steel Studs: ASTM C 645; minimum base metal thickness of 0.0312 inch (0.79 mm); Depth indicated on Drawings.
      c. Hat Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep; Minimum base metal thickness of 0.0312 inch (0.79 mm).

   6. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission. Configuration: Hat shaped.
   7. Grid Suspension System for Ceilings: ASTM C 645, direct hung system composed of main beams and cross furring members that interlock.

E. Gypsum Board: ASTM C 1396/C 1396M, applicable to type of gypsum board indicated and whichever is more stringent.
   1. Core: Use Type X throughout
      a. Thickness: 5/8 inch (15.9 mm).

b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2. Ceiling Type: Manufactured for sag resistance
   a. Thickness: 1/2 inch (13mm).
   b. Long Edges: Tapered.

3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces. Core:
   a. Thickness: 5/8 inch (15.9 mm).
   b. Long Edges: Tapered.

F. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C 1278/C 1278M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
   1. Core and Thickness: 1/2 inch (12.7 mm) or 5/8 inch (15.9 mm) to match conditions, Type X.
   2. Long Edge: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

G. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325.
   1. Thickness: 5/8 inch (15.9 mm) to match conditions.
   2. Long Edges: Standard.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

H. Exterior Trim: ASTM C 1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
   1. Shapes:
      a. Cornerbead.
      b. LC Bead: J shaped; exposed long flange receives joint compound.
      c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.

I. Interior Trim: ASTM C 1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
   1. Poly Vinyl Chloride (PVC) compound meeting the requirements of ASTM C1047. ASTM D3678, ASTM D3679, and ASTM D4216.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC Bead: J shaped; exposed long flange receives joint compound.
      d. L Bead: L shaped; exposed long flange receives joint compound.
      e. U Bead: J shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.

   3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fry Reglet Corporation; (800) 237-9773.
      b. Gordon, Inc.; (888) 877-8746.
      c. Pittcon Industries; (301) 927-1000.
      d. USG Corporation.

J. Continuous Corner: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer. Provide Pittcon Softforms SO-HSE-90 or Schluter.

1. Basis of Design: Pittcon Softforms SO-HSE-90; Subject to compliance with requirements, provide basis of design or comparable by one of the following:
   a. Fry Reglet Corporation; (800) 237-9773.
   b. Pittcon Industries; (301) 927-1000.
   c. Schluter; (888) 472-4588.

K. Joint Treatment: ASTM C 475/C 475M.
1. Joint Tape:
   a. Exterior Gypsum Soffit Board: Paper.
   b. Joint Tape, Interior Gypsum Board: Paper.

2. Joint Compound:
   a. Gypsum Board: Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
      1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
         a) Use setting type compound for installing paper faced metal trim accessories.
      2) Fill Coat: For second coat, use setting type, sandable topping compound.
      3) Finish Coat: For third coat, use setting type, sandable topping compound.
      4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.
   b. Cementitious Units: Recommended by backer unit manufacturer.
   c. Tile Backing Panels: Recommended by backer unit manufacturer.
   d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
   e. J

L. Auxiliary Gypsum Materials: Comply with referenced installation standards and manufacturer's written recommendations.
1. Steel Drill Screws: ASTM C 1002, use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

3. Control Joints: Metal (USG #093 / Dietrich 093 Control Joint) type with 1/4 inch open joint, perforated flanges for floating in place.
4. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti, Inc.;(800) 879-8000.
      2) Pecora Corporation; (800) 523-6688.
      3) Specified Technologies, Inc.; (800) 992-1180.
      4) United States Gypsum Company; (800) 950-3839.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

B. Gypsum Board Assemblies: Comply with requirements in ASTM C 840 applicable to framing installation.

C. Control joints shall be located 30 feet-0 inches on center maximum and along building expansion joints, unless noted otherwise on drawings. Locations shall be reviewed with Architect prior to final placement.

D. Suspension System: Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
   1. Suspend hangers from building structure:
      a. Install hangers plumb and free from contact with insulation or objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
      b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
         1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
      c. Do not attach hangers to steel roof deck.
      d. Do not attach hangers to permanent metal forms. Furnish cast in place hanger inserts that extend through forms.
      e. Do not attach hangers to rolled in hanger tabs of composite steel floor deck.
      f. Do not connect or suspend steel framing from ducts, pipes, or conduit.

   2. Fire Resistance Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track. Do not install rivets.

F. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
   a. Acoustical Sealant: Install continuous ribbon of acoustical sealant under floor track. Refer to Section 07 92 00.
   b. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
      1) Install two studs at each jamb, unless otherwise indicated.
      2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
      3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

   c. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

G. Gypsum Panels: Comply with ASTM C 840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
4. Form control and expansion joints with space between edges of adjoining gypsum panels.
5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
   a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
   b. Fit gypsum panels around ducts, pipes, and conduits.
   c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.

6. Isolate perimeter of gypsum board applied to nonload bearing partitions at structural abutments and floors. Provide 1/4 inch to 1/2 inch (6.4mm to 12.7mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
7. Acoustical Sealant: Install continuous ribbon of acoustical sealant under floor track. Refer to Section 07 92 00.
8. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

H. Gypsum Board: Install interior gypsum board where indicated on drawings.
   1. Single Layer Application:
      a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
      b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

   2. Multilayer Application:
      a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
      b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
      c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

I. Backing Panels:
   1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

J. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
   1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
   2. Fasten with corrosion-resistant screws.

K. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
   1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
   2. Exterior Trim: Install in the following locations:
      a. Cornerbead: Use at outside corners.
      b. LC Bead: Use at exposed panel edges.

   3. Interior Trim: Install in the following locations:
      a. Cornerbead: Use at outside corners, unless otherwise indicated.
      b. Bullnose Bead: Use at outside corners.
      c. LC Bead: Use at exposed panel edges.
      d. L Bead: Use where indicated or necessary.
      e. U Bead: Use at exposed panel edges.

L. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   b. Level 2: Panels that are substrate for tile.
   c. Level 3: Surfaces be coated with drywall primer prior to final finishes. Heavy or medium texture finishes before final painting, or where heavy-grade wall coverings are to be applied as the final decoration. This level of finish is not recommended where smooth painted surfaces, or light to medium weight wall coverings as specified. Janitorial, Electrical, Technology, & Mechanical Rooms.
   d. Level 4: For surfaces receiving wall coverings of semigloss and eggshell paints. Hallways, Classrooms & Offices with ceilings 10’ or lower
   e. Level 5: For surfaces receiving semigloss and eggshell paint and surfaces subjected to severe lighting. Banda Hall, Libraries, Commons, Flex Spaces & Hallways with Ceilings higher than 10’.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.5 WORKMANSHIP TOLERANCES

A. Visual: Correct any nicks, bumps, out-of-level or out - of-plumb areas detectable to the naked eye.

B. Walls: 3/8 inch maximum deviation from vertical.

C. Bumps in Boards: Maximum 1/8 inch in 24 inches.

D. Corners: Maximum out-of-square 1/8 inch in 16 inches.

E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.

F. Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abutts other material or when end is exposed.

G. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.

3.6 COMMENCEMENT RESTRICTIONS

A. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected.

END OF SECTION 09 21 16

SECTION 09 22 26.23 - METAL SUSPENSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:
   1. Suspension System Framing and Furring for Plaster and Gypsum Board Assemblies
   2. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.

B. Alternates
   1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.

   2. Submittals, which do not provide adequate data for the product evaluation, will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Furring System component profiles and sizes; Compliance with the referenced standards.

1.3 RELATED SECTIONS

A. Section 09 51 00 – Acoustical Ceiling Panels.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   4. ASTM D 610 Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces.
   5. ASTM B 117 Standard Practice for Operating Salt Spray (Fog) Apparatus
   6. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
   7. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

8. ASTM C 1858 Standard Practice for Design, Construction, and Material Requirements for Direct Hung Suspended T-bar Type Ceiling Systems Intended to Receive Gypsum Panel Products in Areas Subject to Earthquake Ground Motions.
9. ASTM C 645 Standard Specification for Nonstructural Steel Framing Members.
10. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
11. ASTM C1002 Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
12. ASTM E 119 Standard Test Method for Fire Tests of Building Construction and Material (if applicable).
13. NOA #15-0127.04 Miami/Dade Wind Uplift.
14. NOA #14-1204.05 Miami/Dade Impact.
15. ESR-1289 ICC-ES Evaluation Report.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical literature.

B. Samples: 8 inch long samples of suspension system components, including main runner, cross tees, and angle molding

C. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: To ensure proper interface, all drywall furring components shall be produced or supplied by a single manufacturer.

B. All accessory components from other manufacturers shall conform to ASTM standards.

C. Fire Resistance Ratings: As indicated by reference to design designations in UL Fire Resistance Directory, for types of assemblies in which drywall ceilings function as a fire protective membrane and tested per ASTM E 119. Installation in accordance with the UL Design being referenced.

D. Coordination of Work:
1. Coordinate drywall furring work with installers of related work including, but not limited to: acoustical ceilings, building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.
2. All work above the ceiling line should be completed prior to installing the drywall sheet goods. There should be no materials resting against or wrapped around the suspension system, hanger wires or ties.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

1.8 WARRANTY

A. Suspensions System: Submit a written limited warranty executed by the manufacturer, agreeing to repair or replace grid components that are supplied with a hot-dipped galvanized coating or

aluminum base material. Failures include, but are not limited to the occurrence of 50% red rust as defined by ASTM D 610 test procedures as a result of defects in materials or factory workmanship.

B. Warranty Period:
   1. Grid: Ten (10) years from date of installation.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Suspension Systems Basis of Design: Armstrong World Industries, Inc. or comparable product approved by Architect. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.

2.2 SUSPENSION SYSTEMS

A. Components:
   1. Main Beam: Shall be double-web construction (minimum 0.0179 inch prior to protective coating, ASTM C645), hot dipped galvanized (per ASTM A653).
      a. **HD8906/HD890610**: 1-11/16 inch web height, 1-1/2 inch flange, available with G40 or G90 hot dipped galvanization.

   2. Primary Cross Tees: Shall be double-web steel construction (minimum 0.0179 inch prior to protective coating, ASTM C645), hot dipped galvanized (minimum G40 or G90 per ASTM A653)
      a. **XL8945P**: 48 inch, web height 1-1/2 inch with rectangular bulb and pre-finished 1-1/2 inch knurled flange

   3. Wall Molding:
      a. **LAM-12**: 12 foot Locking Angle Molding, 1-1/4 inch x 1-1/4 inch with pre-engineered locking tabs punched 8 inches on center, knurled surface, screw stop hem, pre-punched holes in top flange, 4” O.C., .018 mil. 25g.
      b. **KAM -12**: 12 foot Knurled Angle molding, 1-1/4 inch x 1-1/4 inch, knurled surface, screw stop hem, pre-punched holes in top flange, 4” O.C., .018 mil. 25g.

   4. Transition Molding: Drywall to Acoustical ceiling.
      a. Pre-Painted Armstrong Global White integral acoustical flange and drywall taping flange, hot dipped cold rolled steel.
         A. **7906**: 120 inch “F” Flush vertical transition

   5. Clips:
      a. **DWACS, DW50, DW58**: Drywall Attachment Clip for transitions to acoustical ceilings.
      b. **DW90C**: 90 degree, Drywall Angle Clip.
      c. **XTAC**: Cross Tee Adapter Clip.

   6. Screws for wallboard application shall be bugle head screws in accordance with thickness of material used.

7. Metal Trim or Plastic Members (by others):
   a. Corner bead: Minimum #26 gauge, zinc alloy or plastic square edge type with expanded flanges.
   b. Casing bead: Minimum #24 gauge, zinc alloy or plastic square edge type with expanded flanges.
   c. Control Joints: Minimum #26 gauge, roll-formed zinc alloy, extruded aluminum or plastic with expanded flanges.
   d. Special Trim Shapes: As detailed on plans, extruded aluminum with acrylic coating by Fry Reglet or approved equal.
   e. Metal Lath: 3.4 lbs/square yard, galvanized 3/8 inch diamond mesh or flat rib lath; security lath for applications requiring high degree of security.

B. Structural Classification:
   1. Main Beam shall be heavy duty per ASTM C 635.
   2. Classification can require wires to be closer together for additional loading when used to support double layer gypsum, verticals, slopes, domes, half barrels, circles, soffits, canopies, and step conditions, which call for loading or unusual designs and shapes in drywall construction. Using cross tees in the construction of circles, barrels, etc. is common in order to hold the radius.
   3. Deflection of fastening suspension system supporting light fixtures, ceiling grilles, access doors, verticals, and horizontal loads shall have a maximum deflection of 1/360 of the span.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install suspension system and panels in accordance with the manufacturer's instructions, in compliance with ASTM installation standard, and with applicable codes as required by the authorities having jurisdiction.

B. The Armstrong Drywall Grid System can be installed in interior or exterior applications.

C. To secure to metal clips, concrete inserts, steel bar joist or steel deck, use power actuated fastener, or insert. Coordinate placement for hanger wire spaced as required for expected ceiling loads and layout.

D. Install hanger wire as required with necessary on center spacing to support expected ceiling load requirements, following local practices, codes and regulations. Provide additional wires at light fixtures, grilles, and access doors where necessary. A pigtail knot shall be used with three tight wraps at top and bottom fastening locations.

E. Add additional wire as needed when using compatible clips and accessories.

F. Control Joints: Roll-formed zinc alloy, aluminum, or plastic as required for expansion and contraction as shown on drawings

G. Expansion Joints: Roll-formed zinc alloy, aluminum, or plastic as required for expansion and contraction as shown on drawings.

H. Main beams shall be suspended from the overhead construction with hanger wire, spaced as required for expected ceiling loads, along the length of the main beams.

I. Install cross tees at on center spacing as specified by the drywall manufacturer. Typical drywall cross tee spacing:
   1. 16 inches on center with 5/8 or 1/2 inch gypsum board.
   2. 24 inches on center with 5/8 inch gypsum board.

J. Other items such as wood, sheet metal, or plastic panels should be screwed to comply with deflection limit equivalent to that of the ceiling installation.

K. Use channel molding or angle molding to interface with Drywall Grid System to provide perimeter attachment or to obtain drop soffits, verticals, slopes, etc.

L. To suspend a second ceiling beneath a new or existing drywall ceiling, without breaching the integrity of the upper ceiling, use the Drywall Clip. To form a transition from a drywall ceiling to an acoustical ceiling, use the Drywall Transition Clips spaced as required for expected loads.

M. For light fixtures (Type G, Type F) use secondary framing cross tees as required to frame opening.

N. Single cross tees in a rout hole to be secured by 7/16 inch framing screw or alternative methods.

3.2 INSTALLATION - EXTERIOR APPLICATIONS

A. Use G90 components for exterior applications.

B. Use vertical bracing as required by codes and standards in accordance with local jurisdiction (non-fire rated installations).

C. Install main beams as required according to Wind Uplift Design or local codes and standards.

D. Install cross tees as required according to Wind Uplift Design or local codes and standards, with additional tees when point loading (vertical), and with additional hanger at midspan of cross tee, as needed.

3.3 INSTALLATION - INTERIOR APPLICATIONS

A. Install main beams and cross tees at the on center spacing required for ceiling loading, and location of in-ceiling services.

B. Additional bracing as required by code.

3.4 INSTALLATION - RADIUS APPLICATIONS

A. Determine the bow or camber (Convex or Concave) in a main runner.

B. Establish a jig or pattern on a flat surface, mark locations to cut main beam, and use four pan head screws to fasten a Radius Clip (RC2) flat to the web between the bulb and the flange per the manufacturer's instructions.

C. Install main beams with on center spacing and wire spacing, as needed, to support expected ceiling load.

D. Additional bracing may be required by code.

E. Install cross tees at on center spacing as specified by the manufacturer.

END OF SECTION 09 22 26.23

SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Thin set glazed wall tile, base and necessary trim shapes, mortar and grout, expansion joints, sealants, transition strips, and accessories shown or required to complete work.

1.3 RELATED SECTIONS

A. Section 09 65 13 – Resilient Base

B. Section 05 77 00 – Decorative Extruded Metal

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with values determined by testing identical products per ASTM C 1028:
   1. Level Surfaces: Minimum 0.6.
   2. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

A. Product Data: Technical data including data sheets, installation recommendation, and recommended joint widths.

B. Shop Drawings: Show locations of each type of tile and tile pattern.
   1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples: Submit samples showing full range of color and texture variations expected.
   1. Full size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Waterproof membrane in 6 x 6-inch sample.
   4. Thresholds in 6 inch (150 mm) lengths.

D. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements for slip resistance.

E. Maintenance Instructions: Submit maintenance instructions for each type of product specified.

F. Certifications:
   1. Provide Master Grade Certificate as specified in ANSI A137.1.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
   2. Surface Burning Characteristics: ASTM E 84; identify products with appropriate markings of applicable testing agency.
      a. Flame Spread Index: 25 or less.
      b. Smoke Developed Index: 450 or less.

   3. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
   1. Stone thresholds.
   2. Waterproofing.
   3. Joint sealants.
   4. Cementitious backer units.
   5. Metal edge strips.

E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of each type of wall tile installation.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

C. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

B. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.9 EXTRA STOCK

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full size units equal to three (3) percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to three (3) percent of amount installed for each type, composition, and color indicated.

1.10 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.11 WARRANTY

A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Damaged tile, including broken or chipped edges.
   2. Loose or missing tile.
   3. Noticeable deterioration or discoloring of tile or grout.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed whose product meets or exceed the specifications may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.
   1. Ceramic Tile:
      a. American Marazzi Tile, Inc.; (972) 226-0110.
      b. American Olean Tile Co.; (214) 398-1411.
      c. American Tile; (713) 939-1077.
      d. Dal-Tile Corp.; (713) 481-5893.
      e. Interceramic, USA; (800) 496-8453.
      f. United States Ceramic Tile Co.; (800) 321-0684.

   2. Tile Setting and Grout Materials: Those manufactured by the approved tile manufacturers named above or any of the following as approved by the tile manufacturer for use with his tile and to suit application.

a. Custom Building Products, Seal Beach, CA; (562) 598-8808.
b. Dal-Tile Corp., Dallas, TX; (713) 481-5893.
c. Laticrete International, Inc., Bethany, CT; (800) 243-4788.
d. MAPEI Corp, Deerfield Beach, FL; (954) 246-8888.

2.2 INTERIOR TILES

A. Ceramic Tile:
1. Wall Tile: **CWT-1, CWT-2, CWT-3, CWT-4**
a. Type/Size: Refer to finish schedules and contract documents.
b. Borders, Pattern(s) and locations: As shown on drawings.
c. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints. Provide built-up cove base at showers as shown or required.
d. Colors: As selected by Architect from manufacturer's available colors, but for pricing purposes, Offers may use 40 percent from Price Group I, 20 percent from Price Group II, 20 percent from Price Group III, 20 percent from Price Group IV.

B. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808, (800)-933-8453, Ultraflex 3 as manufactured by Mapei Americas, Deerfield Beach, FL; (800)-426-2734.

C. Grout: LATICRETE® Perma Color Select as manufactured by Laticrete International, Inc., Prism Sure Color as manufactured by Custom Building Products, Ultracolor Plus FA as manufactured by MAPEI, or Architect approved equal by any one (1) of the approved manufacturers listed above. No substitutions. Color shall be as selected by Architect from manufacturer's standard colors.

D. Epoxy Grout (At wet areas and restroom & Health Care applications): Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
1. CEG Lite as manufactured by Custom Building Products; (562) 598-8808.
2. LATICRETE® SpectraLOCK PRO Premium Stainless Grout manufactured by Laticrete International, Inc.; (800) 243-4788.
3. Kerapoxy CQ, Epoxy Grout manufactured be Mapei Americas; (800)-426-2734.

E. Crack Isolation Membrane:
1. Sheet membrane used to eliminate transmission of substrate cracks from one (1) of the following approved Products/Manufacturers:
a. DalSIM 500EX manufactured by Dal-Tile.
b. Crackbuster manufactured by Custom Building Products.
c. Mapeguard 2 manufactured by Mapei.
d. Nobleseal CIS manufactured by The Noble Company.
e. Fracture Ban manufacrteud by Laticrete.

2. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
a. Blue 92 manufactured by Laticrete International, Inc.
b. Fracturefree manufactured by Custom Building Products.
c. Mapelastic CI manufactured by Mapei.

2.4 EXPANSION JOINTS

A. Expansion Joint Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.

B. Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.

2.5 MISCELLANEOUS MATERIALS

A. Edge Protection and Transition Strips:
   1. Of type and size recommended to suit application. Color shall be as selected by Architect from manufacturer's standard colors.
   2. Approved Manufacturer: Schluter® Systems LP, Plattsburg, NY; (800) 472-4588.
   3. Provide all corners and connectors as required for a complete and detailed finished installation.
   4. Edge Protection – Corner: Schluter® - ECK-E transition strips in stainless steel finish at restrooms.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination: Examine substrates for expansion joints and defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
   1. Dry, clean, free of oily or waxy films, free of curing compounds.
   2. Firm and level within specified tolerances.
   3. Minimum of 40 degrees and rising.

B. Tile contractor shall examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work. Verify that slab is free of cracks, waxy or oily films, and is well cured. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

3.2 INSTALLATION

A. Align joints (no staggering)

B. Set interior wall tile and grout in accordance with TCA W244 on tile backer cement board at wet areas, showers, and restrooms, TCA W243 on tile backer gypsum board at dry areas not exposed to water or moisture, and TCA W202 on concrete masonry unit (CMU) substrates.

C. Allow minimum of 24 hours after tile is set before grouting.

D. Lay out tile so that the minimum size tile used is 1/2 size.

F. Form internal angles square.

G. Install expansion joints in accordance with TCA publication EJ171.

H. Damp cure grout in accordance with manufacturer's recommendations.

3.3 CLEANING AND PROTECTION

A. Clean work at completion of installation, remove excess grout from tile surfaces. Clean tile and grout surfaces prior to installation of plumbing fixtures.

B. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.

C. Remove grout from adjacent finish surfaces.

D. Protect finished installation until final acceptance.

END OF SECTION 09 30 13

SECTION 09 30 19 - PORCELAIN TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Thin set porcelain tile, mortar and grout, sealants, and accessories shown or required to complete work.

1.3 SUBMITTALS

A. Product Data: Technical data including data sheets, installation recommendation, and recommended joint widths.

B. Shop Drawings: Show locations of each type of tile and tile pattern.
   1. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples: Submit samples showing full range of color and texture variations expected.
   1. Full size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Waterproof membrane in 6 x 6-inch sample.
   4. Thresholds in 6 inch (150 mm) lengths.

D. Test Reports: Submit test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of tile products with requirements for slip resistance.

E. Maintenance Instructions: Submit maintenance instructions for each type of product specified.

F. Certifications:
   1. Provide Master Grade Certificate as specified in ANSI A137.1.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
   2. Surface Burning Characteristics: ASTM E 84; identify products with appropriate markings of applicable testing agency.
      a. Flame Spread Index: 25 or less.
      b. Smoke Developed Index: 450 or less.

   3. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

c. Texas Accessibility Standards (TAS) 2012.

B. American National Standards Institute (ANSI)
1. Installation Specifications:
a. A108, Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
b. A108.10, Installation of Grout in Tilework.

2. Material Specifications:
a. A118.4, Modified Dry Set Cement Mortar.
b. A118.6, Ceramic Tile Grouts.
c. A137.1, Ceramic Tile.

C. Source Limitations for Tile: Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

D. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

E. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
1. Stone thresholds.
2. Waterproofing.
3. Joint sealants.
4. Cementitious backer units.
5. Metal edge strips.

F. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products. Contractor shall provide certified moisture testing results per ASTM F2170 (*Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*) in new construction or ASTM F1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) in renovations to Architect and Owner prior to floor installation. Acceptable moisture content of concrete sub floor shall be within approved manufacture limits or lower prior to installation.

G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

C. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.

C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full size units equal to three (3) percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to three (3) percent of amount installed for each type, composition, and color indicated.

1.8 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.9 WARRANTY

A. Warrant the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to, the following:
   1. Damaged tile, including broken or chipped edges.
   2. Loose or missing tile.
   3. Noticeable deterioration or discoloring of tile or grout.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specifications are based on products of manufacturers specified. Manufacturers listed below who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.
   1. Porcelain Tile:
      a. American Marazzi Tile, Inc.; (972) 226-0110.

b. American Olean Tile Co.; (214) 398-1411.
c. American Tile; (713) 939-1077.
d. Crossville Ceramics Co.; (931) 484-2110.
e. Dal-Tile Corp., Dallas, TX; (713) 481-5893.
f. Interceramic, USA; (800) 496-8453.

2. Tile Setting and Grout Materials: Those manufactured by any one (1) of the following. No substitutions.
a. Custom Building Products; (562) 598-8808.
b. Dal-Tile Corp.; (713) 481-5893.
c. Laticrete International, Inc., Bethany, CT; (800) 243-4788.
d. Mapei Americas; (800) 426-2734.

B. Specifications are based on porcelain tile as manufactured by Dal-Tile Corp. Other manufacturers listed shall provide colors and finish equivalent to those specified.

2.2 MATERIALS

A. Floor Tile: **MFT-1, MFB-1**
1. Type/Size: Refr to finish schedules and contract documents.
2. Borders, Pattern(s) and Locations: As shown on drawings.
3. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
4. Base: Four (4) inch high porcelain tile base to match porcelain tile.
5. Outside corners: To have aluminum Schluter Quadec finishing edge, unless otherwise noted.

B. Wall Tile: **MWT-1, PWT-1**
1. Type/Size: Refr to finish schedules and contract documents.
6. Borders, Pattern(s) and Locations: As shown on drawings.
7. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints.
8. Outside edges: To have aluminum edge protection as specified.

C. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, Inc., Bethany, CT; (800) 243-4788, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products, Seal Beach, CA; (562) 598-8808, or 1300 Universal Bonding Mortar as manufactured Dal-Tile Corp., Dallas, TX; (800)-933-8453, Ultraflex 3 as manufactured by Mapei Americas, Deerfield Beach, FL; (800)-426-2734. No substitutions.

D. Grout: LATICRETE® Perma Color Select as manufactured by Laticrete International, Inc., Prism Sure Color as manufactured by Custom Building Products, Ultracolor Plus FA as manufactured by MAPEI, or Architect approved equal by any one (1) of the approved manufacturers listed above. No substitutions. Color shall be as selected by Architect from manufacturer's standard colors.

E. Epoxy Grout (At wet areas and restroom floors): Use one (1) of the following 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors:
1. ARDEX L.P., WA Epoxy Grout; (724) 203-5000.
2. Polyblend® Tile Grout with 100 percent Solids Epoxy manufactured by Custom Building Products; (562) 598-8808.
3. LATICRETE® SpectraLOCK PRO Stainless Grout manufactured by Laticrete International, Inc.; (800) 243-4788.

4. Kerapoxy IEG, 100% Solids, Industrial-Grade Epoxy Grout manufactured be Mapei Americas; (800)-426-2734.

F. Crack Isolation Membrane:
1. Sheet membrane used to eliminate transmission of substrate cracks from one (1) of the following approved Products/Manufacturers:
   a. Dalseal CIS manufactured by Dal-Tile.
   b. Crackbuster manufactured by Custom Building Products.
   c. Mapelastic SM manufactured by Mapei.
   d. Nobleseal CIS manufactured by The Noble Company.
   e. Tileguard manufactured by Polyguard Products, Inc.

2. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
   a. Blue 92 manufactured by Laticrete International, Inc.
   b. Fracturefree manufactured by Custom Building Products.

G. Expansion Joint:
1. Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
2. Typical Conditions except as specified below: Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.
3. Conditions exposed to chemicals, food processing, etc.: Polysulfide sealant over filler. ASTM C920, Grade P, Class 25, Uses T and M. Polyspec Thiokol, or Architect approved equal. Self-leveling and flexible sealant over filler of type instructed by manufacturer to suit application. Sealant shall match grout color. Expansion joints shall conform to TCA EJ171.

H. Latex Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by ARDEX ENGINEERED CEMENTS; (724) 203-5000 or comparable product approved by Architect.

I. Edge Protection and Transition Strips:
1. Basis of Design: Schluter® Systems LP, Plattsburg, NY; (800) 472-4588.
2. Porcelain Tile to Gyp. Bd.: Schluter® - QUADEC transition strips in aluminum finish at all porcelain tile wainscot to gyp board transition locations.
3. Porcelain Tile to Porcelain Tile: Schluter® - QUADEC transition strips in aluminum finish at all porcelain tile wall outside corner locations.
4. Porcelain Tile to Carpet: Schluter® - SCHIENE transition strips in aluminum finish at porcelain tile to carpet transition locations.
5. Porcelain Tile to Sealed Concrete: Schluter® - RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
6. Edge Protection: Schluter® - ECK-E. Brushed Stainless.
7. Provide all corners and connectors as required for a complete and detailed finished installation.

2.3 EXTRA TILE

A. Deliver four (4) unopened boxes of tile of each color tile and base from the same tile production run to the Owner at Substantial Completion.

PART 3 - EXECUTION

3.1 PREPARATION

A. By General Contractor:
   1. Protect surrounding work from damage or disfiguration.
   2. Vacuum clean and damp clean existing substrate surfaces.

B. By Tile Contractor:
   1. Examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work.
   2. Examine substrates defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
      a. Free of cracks, dry, clean, free of oily or waxy films, free of curing compounds.
      b. Well cured, firm and level within TCA specified tolerances.
      c. Minimum of 40 degrees F and rising.

C. Absence of such notification shall constitute acceptance of responsibility by tile contractor.

3.2 INSTALLATION

A. Crack Isolation Membrane:
   1. Install crack isolation membrane under tile over building control joints and substrate cracks up to 1/8 inch. Apply a 30 inch wide strip centered on control joint or crack. Install in accordance with TCA F125 and manufacturer's instructions.
   2. Install joint sealant in joint of first tile on both sides of control joint and crack.
   3. Install membrane with products or methods approved by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.

B. Install porcelain wall tile and porcelain pavers with aligned joints (no staggering), 1/8 inch to 3/16 inch joint width.

C. Install porcelain pavers over crack isolation membrane in locations shown on drawings in accordance with TCA F125 and ANSI A108.5 recommendations and manufacturer’s instructions.

D. Do not use damaged porcelain tile, including those with broken or cracked edges.

E. Lay out all work so that, where possible, no tiles less than half size occur.

F. Install expansion joints in accordance with TCA publication EJ171. Install porcelain tile joints aligned with floor joints.

G. Install grout in accordance with ANSI A108.10 and manufacturer's instructions.

H. Install edge protection and transition strips in accordance with manufacturer’s instructions.

I. Damp cure grout in accordance with manufacturer's recommendations. Clean all porcelain tile surfaces upon completion. Protect finish porcelain tile work from damage.

3.3 CLEANING AND PROTECTION

A. Clean work at completion of installation, remove excess grout from porcelain tile surfaces. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.

B. Remove grout from adjacent finish surfaces.

C. Protect finished installation until final acceptance.

D. Do not permit traffic over finished floor surface.

3.4 REPAIR

A. Repair or replace damaged porcelain tile, including those with broken or cracked edges at no expense to Owner.

END OF SECTION 09 30 19

THIS PAGE WAS INTENTIONALLY LEFT BLANK

SECTION 09 51 00 - ACOUSTICAL CEILING PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Acoustical panels.
   2. Concealed and exposed suspension systems for ceilings.
   3. Accessories necessary for a complete installation.

1.3 RELATED SECTIONS

A. Section 01 60 16 – Interior Design Selections.

B. Section 09 21 16 – Gypsum Board Assemblies.

C. Division 23 – Mechanical: Air diffusers and mechanical items penetrating ceiling.

D. Division 26 – Electrical: Lighting and electrical items penetrating ceiling.

1.4 SUBMITTALS

A. Product Data: Technical data for each product including installation instructions.

B. Samples:
   1. Acoustic Panel: Set of 6 inch (150 mm) square samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12 inch (300 mm) long samples of each type, finish, and color.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which suspension systems will be attached.
   3. Size and location of initial access modules for acoustical panels.
   4. Items penetrating finished ceiling including but not limited to the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
   5. Perimeter moldings.

D. Maintenance Data: Manufacturer data for finishes for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements of the IBC for interior finishes.
   2. Acoustical Panel Standard: ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance.
      a. Mounting Method for Measuring NRC: Plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

   3. Surface Burning Characteristics: Ceiling panels with surface burning characteristics complying with IBC Chapter 8 and ASTM E 1264 for Class A materials determined by testing identical products in accordance with ASTM E 84:
      a. Flame Spread Index : 25 or less
      b. Smoke Developed Index: 450 or less.

   4. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
   2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Comply with applicable regulations regarding toxic and hazardous materials.
   1. Coating Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment; and showing no mold or mildew growth when tested in accordance with ASTM D3273.
   2. Panel Based Antimicrobial Treatment: Provide acoustical panels manufactured with antimicrobial treatment in the panels.

D. Preinstallation Conference: Conduct conference at site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to site in original, unopened packages and store in a fully enclosed, conditioned space protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, allow panels to attain room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
   1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 WARRANTY

A. Standard Ceiling Panels: Warrant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.

B. Sag Resistant Ceiling Panels: warrant products to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of fifteen (15) years from the date of Substantial Completion.

C. Standard Suspension System: Suspension systems shall be warranted to be free from defects in material or factory workmanship and shall not incur 50 percent red rust as defined by ASTM B117 test procedures for a period of fifteen (15) years from the date of Substantial Completion.

D. Suspension system / ceiling panels: Provide manufacturers standard fifteen (15) years warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust as defined by ASTM b117 test during the period of the warranty, extra materials.

1.9 EXTRA STOCK

A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full size panels equal to 1 percent of quality installed or 2 full unopened containers, whichever is greater.
   2. Suspension System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
   3. Hold Down Clips: Equal to 2 percent of quantity installed.
   4. Impact Clips: Equal to 2 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Manufacturers listed whose product meets or exceed the specifications may be used on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.
   1. Concealed and Exposed Suspension Grid:
      a. Armstrong World Industries, Inc.
      b. CertainTeed Corporation.
      c. Chicago Metallic; Rockfon (Roxul Inc.).
      d. Hunter Douglas.
      e. USG Interiors.
      f. Rockfon (Roxul Inc.).

   2. Acoustical Ceiling Panel:
      a. Armstrong World Industries, Inc.
      b. CertainTeed Corporation.
      c. Rockfon (Roxul Inc.).
      d. Tectum Inc.
      e. USG Interiors.

   3. Molding and Edge Trim:
      a. Armstrong World Industries, Inc.

b. CertainTeed Corp.
c. Chicago Metallic Corporation.
d. Fry Reglet Corporation.
e. Gordon, Inc.
f. Rockfon (Roxul Inc.).
g. USG Interiors, Inc.; Subsidiary of USG Corporation.

4. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

5. Acoustical Sealant for Concealed Joints:
   a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
   b. Pecora Corporation; AIS-919.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
   1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 METAL SUSPENSION SYSTEM

A. Metal Suspension System: Direct hung metal suspension systems of types, structural classifications, and finishes indicated complying with applicable requirements in ASTM C 635/C 635M.
   1. High Humidity Finish: Comply with ASTM C 635/C 635M requirements for *Coating Classification for Severe Environment Performance* where high humidity finishes are indicated.
   2. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1 *Direct Hung*, unless otherwise indicated. Comply with seismic design requirements.
      a. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
         1) Type: Cast in place, postinstalled expansion or postinstalled bonded anchors.
         2) Corrosion Protection: Carbon steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
         3) Corrosion Protection: Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
         4) Corrosion Protection: Components fabricated from nickel copper alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

      b. Power Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

   3. Wire Hangers, Braces, and Ties:

a. Zinc Coated, Carbon Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
b. Stainless Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
c. Nickel Copper Alloy Wire: ASTM B 164, nickel copper alloy UNS No. N04400.
d. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1 Direct Hung) will be less than yield stress of wire, but provide not less than 0.106 inch (2.69 mm) diameter wire.

4. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust inhibitive paint.
5. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04 inch (1 mm) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16 inch (8 mm) diameter bolts.
6. Hold Down Clips: Provide hold down clips spaced 24 inches (610 mm) o.c. on all cross tees in areas with exterior opening larger than 48” x 96”.
7. Impact Clips: Provide impact clip system designed to absorb impact forces against acoustical panels in Gymnasiums.
8. Aluminum cap for use over steel grid in kitchen areas or where shown on drawings or required.

B. Metal Suspension Systems:

1. Narrow Face, Steel Capped, Double Web, Steel Suspension System: Main and cross runners roll formed from cold rolled steel sheet; prepainted, electrolytically zinc coated, or hot dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished, cold rolled, 9/16 inch (15 mm) wide metal caps on flanges.
   a. Structural Classification: Intermediate-duty system.
   b. Face Design: Flat, flush.
   c. Cap Finish: Color selected by Architect.

2.3 ACOUSTICAL PANELS

A. Acoustic Panel
1. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern:
   a. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
   b. Pattern: CE (perforated, small holes and lightly textured).
2. Color: White.
3. LR: Not less than 0.86.
4. NRC: Not less than 0.90.
5. CAC: Not less than **35**.
6. Edge/Joint Detail: Square Tegular Narrow
7. Thickness: 3/4 inch (19 mm).
8. Modular Size: 24 by 24 inches (610 by 610 mm).
9. Humidity/ Sag Resistance: The resistance of interior coatings to mold and mildew growth is useful in estimating the performance of coatings designed for use in interior environments that promote mold growth and in evaluating compounds that may inhibit such growth and the aggregate levels for their use when tested according to ASTM D 3273.
10. Typical Location: Offices and Coaches Rooms

2.4 TYPICAL LOCATION: MOLDING, TRIM AND ACCESSORIES

A. Shadow Molding: Where an acoustical lay in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding similar to Armstrong Shadow Molding No. 7873.

B. Light Fixture Protection:
   1. Manufacturer: Thermafiber Light Protection Kit by Owens Corning or Type 5/8 or 3/4 P(S) by Armstrong World Industries.
   2. Fire Resistance Rating: Same as ceiling assembly rating.
   3. Locations: At fixtures reinstalled in fire rated ceiling assemblies.

C. Roll Formed, Sheet Metal Edge Moldings and Trim: Type and profile for standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color used for exposed flanges of suspension system runners.
   1. Provide edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
   2. For lay in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
   3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

D. Extruded Aluminum Edge Moldings and Trim: Where indicated, provide extruded aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
   1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
   2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
   3. Baked Enamel or Powder Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

E. Acoustical Sealant: Comply with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
   2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut for compliance with requirements specified that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less than half width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA *Ceiling Systems Handbook*.
   1. Fire Rated Assembly: Install fire-rated ceiling systems according to tested fire rated design.

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers where required and, if permitted with fire resistance rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
   6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast in place hanger inserts, postinstalled mechanical or adhesive anchors, or power actuated fasteners that extend through forms into concrete.
   7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   8. Do not attach hangers to steel deck tabs.
   9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
   10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
   11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast in place or postinstalled anchors.

D. Panel Accessibility: Install panels downward accessible by disengaging hinge support rail on one side of panel from the T Bar Flange or optional A Mount rail flange without the use of tools, for access without removal of panel from the ceiling.

E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

F. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

G. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
   1. Arrange directionally patterned acoustical panels with pattern running in one direction parallel to long axis of space.
   2. For square edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
   3. For reveal edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   4. For reveal edged panels on suspension system members with box shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
   5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
   6. Install hold-down clips in areas indicated, in areas with exterior opening larger than 48” x 96”, where required by authorities having jurisdiction; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
   7. Install clean room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Compliance of seismic design.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
   1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
      a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.

b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

THIS PAGE WAS INTENTIONALLY LEFT BLANK

SECTION 09 65 13 - RESILIENT BASE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Rubber base
2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of product including manufacturer's installation instructions.

B. Samples: Sample of Base Selected or Color Chart if none selected.

C. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Entity having minimum 5 years documented experience who employs workers competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store base and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 85 degrees F (29 degrees C). Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor tile during the following time periods:
1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).

C. Close spaces to traffic for 48 hours after installation.

1.7 EXTRA STOCK

A. Furnish extra materials matching products installed and packaged with protective covering for storage and identified with labels describing contents.
   1. Resilient Base: 1 percent of quality installed or 2 full unopened containers, whichever is greater.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design **(RB-1),** Roppe, 100, Black, 6”H. Other manufacturers are subject to compliance with requirements or comparable product by one of the following:
   1. Flexco Floors.
   2. Johnsite, a division of Tarkett Group.
   3. Mannington Commercial.

B. Rubber Base: ASTM F1861.
   1. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B.
   2. Manufacturing Method: Group I (solid, homogeneous).
   3. Style: Topset cove; minimum 100 foot coil, cut to length required.
   4. Minimum Thickness: 0.125 inch (3.2 mm).
   5. Color: Refer to the Drawings.
   6. Height: 4 inches, unless indicated otherwise.
   7. Outside Corners: Job formed.
   8. Inside Corners: Job formed.

C. Adhesives: Water resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified for other work and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation after correcting unsatisfactory conditions. Installation of resilient flooring and accessories indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Immediately before installation, sweep clean substrates to be covered by resilient base.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for installing flooring. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Extend flooring into toe spaces, door reveals, closets, and similar openings.

B. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

C. Resilient Base: Comply with manufacturer's written instructions for installing resilient base. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
   1. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
   2. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
   3. Do not stretch resilient base during installation.
   4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
   5. Preformed Corners: Install preformed corners before installing straight pieces.
   6. Job Formed Corners:
      a. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
      b. Form without producing discoloration (whitening) at bends.
      c. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
         1) Miter or cope corners to minimize open joints.

END OF SECTION 09 65 13

THIS PAGE WAS INTENTIONALLY LEFT BLANK

SECTION 09 68 00 - CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Carpet and pad.
2. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

A. Product Data: Technical data including installation recommendations for each type of substrate:
1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

B. Samples: For each product and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12 inch (300 mm) long Samples.
3. Carpet Seam: 6 inch (150 mm) Sample.
4. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
5. Carpet base and accessory samples.

C. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.

D. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Building Code: Comply with applicable requirements for the IBC for interior finishes.
   2. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E 648. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
   3. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS).

B. Installer Qualifications: Installer having minimum 5 years documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.

C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab level on a flat surface, stacked no higher than two rolls.

C. Store materials in area of installation for minimum period of 48 hours prior to installation.

D. Protect carpet from damage, dirt, stains, and moisture.

1.7 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.8 COORDINATION

A. Contractor’s responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

1.9 WARRANTY

A. Carpet: Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.
   3. Warranty Period: 25 years from date of Substantial Completion.

1.10 PRE-INSTALLATION CONFERENCE

A. Refer to Section 01 31 00 – Project Management and Coordination.

1.11 EXTRA STOCK

A. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional three (3) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design Manufacturer: Milliken, LLC; Other manufacturers are subject to compliance with requirements:
   1. Bentley Mills; (800) 423-4709.
   2. J&J Flooring Group; (800) 241-4586.
   3. Milliken & Company.
   4. Mohawk Group.
   5. Patcraft.
   6. Shaw Contract Group.
   7. Tandus-Centiva, A Tarkett Company; (800) 248-2878

B. Carpet (CPT-01):
   1. Manufacturer: Shaw, Shifting Fields, as manufactured by Shaw Contract, LLC.
   2. Refer to specification Section 01 60 16 Interior Design Selections, for additional product information

C. Carpet (CPT-02) (Walk-Off):
   1. Basis of Design Manufacturer: Interface, 104934, Smoke, SR799, as manufactured by Interface, LLC.
   2. Type: Patterned carpet tiles.
   3. Construction: Patterned Loop
   4. Size: 50 cm X 50 cm.
   5. Color(s): SR799.
   6. Locations: As shown on drawings.

D. Applied Soil Resistance Treatment: Standard with manufacturer.

E. Antimicrobial Treatment: Standard with manufacturer.

F. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.

G. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.

H. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.

I. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

J. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet and cushion manufacturer.
2. Subfloor finishes comply with requirements specified in Section 03 30 00 for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

A. Comply with CRI 104, Section 7.3 *Site Conditions; Floor Preparation* and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
   1. Direct Glue Down Installation: Comply with CRI 104, Section 9 *Direct Glue Down Installation*.
   2. Stair Installation: Comply with CRI 104, Section 13 *Carpet on Stairs* for glue down installation.

B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
   1. Do not bridge building expansion joints with carpet.
   2. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
   3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, *Patterned Carpet Installations* and with carpet manufacturer's written recommendations.

3.4 CLEANING AND PROTECTING

A. Perform cleaning operations immediately after installing carpet:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
   2. Remove yarns that protrude from carpet surface.
   3. Vacuum carpet using commercial machine with face beater element.

B. Protect installed carpet to comply with CRI 104, Section 16, *Protecting Indoor Installations*.

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer.

END OF SECTION 09 68 00

THIS PAGE WAS INTENTIONALLY LEFT BLANK

SECTION 09 90 00 - PAINTINGS AND COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Surface preparation and field painting of exposed items and surfaces.
   2. Field preparation and painting of factory primed metal products and fabrications.
   3. Accessories necessary for a complete installation.

1.3 DEFINITIONS

A. Standard coating terms defined in ASTM D 16 apply.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
   2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
   3. Semigloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
   4. Full gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.4 SUBMITTALS

A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
   1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
   2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.

B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
   1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
   3. Submit samples on following substrates for review of color and texture only:
      a. Concrete: Provide two 4 inch square samples for each color and finish.
      b. Concrete Masonry: Provide two 4" x 8" samples of masonry, with mortar joint in the center, for each finish and color.
      c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
      d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.

C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with Finish Schedule, Area Detail designating where each product/color/finish was used, product/color/finish was used, product data pages, Manual Safety Data sheets, care and cleaning instructions, touchup procedures, and color samples of each color and finish used.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
2. Performance and Durability:
   a. ASTM D 16 – "Standard Test Method for Load Testing Refractory Shapes at High Temperatures."
   b. ASTM D 2486 – "Standard Test Method for Scrub Resistance of Interior Wall Paint."
   c. ASTM D 2805 – "Standard Test Method for Hiding Power of Paints by Reflectometry."
   d. ASTM D 4828 – "Standard Test Method for Practical Washability of Organic Coatings."
   e. ASTM D 3363 – "Standard Test Method for Film Hardness by Pencil Test."

B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.

C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F (7 degrees C).
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).

B. Do not thin or add water to waterbased paints, including waterbased alkyds.

C. Weather Conditions:
1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).

D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
   1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
   2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

E. Provide lighting level of 80 foot candles (860lx) measured midheight at substrate surface.

F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.8 WARRANTY

A. Written warranty signed by the manufacturer and the installer in which the manufacturer and installer agree to repair or replace paint and primers that fail within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Flaking or delamination of paint with the substrate.
      b. Rust, scale, similar imperfections due to improper surface preparation.
      c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
      d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
      e. Deterioration or loss of color of paint beyond normal weathering.

   2. Warranty Period: Two (2) years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Specifications: Sherwin Williams paints. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
   1. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including per cent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.
   2. Paint Products:
      a. PPG Industries, Inc.
      b. Sherwin-Williams Co.

B. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.

C. Material Quality: Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.

D. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA.

E. Accessories: Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

F. Patching Materials: Latex filler compatible with paint systems.

G. Fastener Head Cover Materials: Latex filler.

2.2 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
   1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.3 COLORS

A. Colors shall be as selected by Architect. Different colors may be selected for each room, and more than one (1) color may be selected in each room.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.

B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
   1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
      a. Concrete: 12 percent.
      b. Fiber Cement Board: 12 percent.
      c. Masonry (Clay and CMUs): 12 percent.
      d. Wood: 15 percent.

e. Gypsum Board: 12 percent.
f. Plaster: 12 percent.

2. Test cementitious and plaster cement/stucco for alkalinity (pH).

C. Gypsum Board Substrates: Verify joints are taped and finishing compound is sanded smooth.

D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.

E. Spray Textured Ceiling Substrates: Verify surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
a. Note: If previously painted surfaces have failed to accept new paint systems, determine cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.

G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
1. All ferrous metal
2. All exterior galvanized metal
3. All exterior wood
4. All interior wood
5. All prime coated hardware
6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
7. Aluminum and copper items, unless noted otherwise. (Painting of exposed pipe, including copper, brass, galvanized and black iron pipe and fittings, *is* included.)
8. All metal grilles, except aluminum, unless otherwise indicated.
9. All exposed gypsum board surfaces, including all mechanical rooms.
10. Sealants of types which should not be painted and to which paint will not adhere.
11. Aluminum, stainless steel, nickel and chrome plated piping and fittings.
12. Miscellaneous other items which normally require painting or are scheduled to be painted.
13. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
14. All exposed mechanical equipment and electrical equipment.
15. Traffic lanes and parking spaces including fire lanes and crosswalks.
16. Rolling doors.
17. Bollards.
18. Loose lintels.
19. Wood Fiber Decks.
20. Refer to MEP specifications for additional items to receive paint.

B. Accessible Parking Space for pavement:
1. "No Parking" painted on any access aisle adjacent to the parking space.

2. Letter height at least 12 inches and a stroke width of at least two inches.
3. Centered within each access aisle adjacent to the parking space.

C. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
1. Preprimed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or preprimed substrates.
2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
4. Seal marks which may bleed through surface finishes.

B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting
1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.

C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.

2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
5. Aluminum Substrates: Remove surface oxidation.

D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.

E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.

F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
1. Remove surface film preventing proper adhesion and bond.
2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
4. Clean corroded iron and steel surfaces.
5. Repair and blend into portland cement plaster.
6. Prime bare surfaces.
7. Tone varnished surfaces with stain bringing to uniform color.
8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.

G. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
    a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
    b. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m).
    c. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
    d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
    e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.

3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.

H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.

K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.

L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

M. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

N. Wood Substrates:
1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

O. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.

P. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
1. Assure compatibility with product of wall covering manufacturer.
2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
3. Apply release coat in accordance with manufacturer's recommendations.

Q. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Do not use thinners for water based paints.
4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
1. The term *exposed surfaces* includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
2. Use applicators and techniques suited for paint and substrate indicated.
3. Provide finish coats compatible with primers.
4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
   a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
   b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
   c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
12. Provide finish coats compatible with primers used.
13. Sand lightly between each succeeding enamel or varnish coat.

B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, operating parts, and labels.

C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
   1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
   1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.

E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
   2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
   3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
   1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
   2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
   3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
   4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
   5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
   6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
   7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.

G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
   1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
   2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
   3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
   4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
   5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
   6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

H. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.

J. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
   1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
   2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

L. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
   1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
   2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
   3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
   4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

A. It is of the upmost importance to the client that the site remains in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.

B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. Provide *Wet Paint* signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.

F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer’s recommendations and environmental regulations.

PART 4 - SCHEDULES

A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.

B. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
   1. Galvanized Metal:
      a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
      b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
      c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300)

   2. Concrete and CMU:
      a. Primer: One (1) coat of Loxon Concrete and Masonry Primer.

b. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System (LX11 Series), 14-18 mils wet, 6.4 – 8.3 mils dry per coat

3. Parking Line and Driveway Paint: Hotline Waterborne Yellow (TM2153) (meets Federal Specification (FS) TTP-1952-F).
4. All piping in mechanical rooms shall be painted in their entirety, in the following colors:
   a. Gas lines: Orange
   b. Domestic cold water: White
   c. Domestic hot water: Pink
   d. Heating hot water: Red
   e. Condenser water: Green
   f. Chilled water: Blue

C. Interior Surfaces:
1. Galvanized Metal:
   a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
   b. Finish: Two (2) coats Pro Industrial Performance Acrylic – Semi-Gloss.

2. Galvanized Metal: (Use for metal hand rails)
   a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
   b. Finish: Two (2) coats Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150.

3. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
   a. Shop coat by others.
   b. One (1) coat over Steel and Aluminum, Pro Industrial Pro-Cryl Universal Primer (B66W610).
   c. Two (2) coats Pro Industrial Acrylic Semi-Gloss, B66 Series.

4. Shop-Primed Ferrous Metals (Use for metal hand rails):
   a. Shop coat by others.
   b. One (1) coat over Steel and Aluminum, Pro Industrial Pro-Cryl Universal Primer (B66W610).
   c. Two (2) coats Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150.

5. Gypsum Wallboard:
   a. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
   b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Eg-Shel (B20W2651 Series).

   Alternate:
   a. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
   b. Finish: Microbicidial Paint: Paint Shield (EPA# 64695-1).
      1) Substitutions must meet EPA #64695-1.

6. Primer Concrete and CMU: (Enamel):
   a. One (1) coat Loxon Block Surfacer (A24W00200).
   b. Finish: Two (2) coats ProMar 200 Zero VOC Latex Semi-Gloss (B31W2651 Series).

7. Gypsum Wallboard: (Epoxy):
   a. Primer: One (1) coat ProMar 200 Zero VOC Latex Primer (B28W2600).
   b. Finish: Two (2) coats Pro Industrial Waterbased Epoxy, Eg-Shel (B73 Series).
      1) Location: Kitchens, bathrooms, and laboratories.
      OR
   c. Finish: Two (2) coats Pro Industrial Pre-Catalyzed, Eg-Shel (K45 Series).
      1) Location: Corridors & Stairwells.

8. CMU: (Epoxy):
   a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46)
   b. Finish: Two (2) coats Pro Industrial Waterbased Epoxy, Eg-Shel (B73 Series).
      1) Location: Kitchens, bathrooms, and laboratories.

9. Concrete and CMU: (Enamel)
   a. Primer: One (1) coat ProMar Block Filler (AB25W25)
   b. Finish: Two (2) coats ProMar 200 OVOC Latex Semi-Gloss (B31-2600 Series)

12. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
   a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
   b. Finish: Two (2) coats bright aluminum paint, S-W BondPlex Aluminum (B71S200).

D. Paint Types: Refer to Section 01 60 16 – Interior Design Selections.

END OF SECTION 09 90 00

SECTION 09 96 00 - HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Exterior Substrates:
   1. Steel Structures
   2.

1.3 REFERENCES

A. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus

B. ASTM D 2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

C. ASTM D 3359 - Standard Test Method for Film Hardness by Pencil Test

D. ASTM D 3363 - Standard Test Method for Film Hardness by Pencil Test

E. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader

F. ASTM D 4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

G. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

H. ASTM D 6386 - Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

I. ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

J. ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

K. ICRI Guide No. 03732 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.

L. SSPC-SP 3 - Power Tool Cleaning.

M. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.

N. SSPC-SP10/NASE 2 - Near White Blast Cleaning

O. SSPC-SP 13/NACE 6 - Surface Preparation of Concrete.

P. SSPC-PA2 - Measurement of Dry Coating with Magnetic Gauges

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Application instructions.
   4. Manufacturer's Safety Data Sheets.

C. Shop Drawings: Submit a complete schedule of products proposed for use, including identifying product names and catalog numbers.
   1. Arrange in same format as Finish Schedule.
   2. Include applicable manufacturer's data and recommendations.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches by 4 inches (76 mm by 102 mm) representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements and are suitable for intended application.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include **recommendations for periodic cleaning and maintenance of coatings specified.**

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all products from a single manufacturer specializing in manufacture of high-performance epoxy coatings with a minimum of 10 years' experience.
   1. Materials shall be standard products of a single manufacturer.
   2. Secondary materials shall be specifically recommended by coating system manufacturer to ensure compatibility of systems.

B. Applicator Qualifications: A firm documented experienced applying paints and coatings similar in material, design, and extent to those indicated for this project, whose work has resulted in applications with a record of successful in-service performance.

C. Regulatory Requirements: Conform to all applicable codes and ordinances for flame, fuel, smoke and volatile organic compounds (VOC) ratings requirements for finishes at time of application.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Located in areas designated by Architect.
   2. Prepare a surface preparation mock-up of each surface condition anticipated for the project.
   3. Prepare a 10 foot by 10 foot (3.05 m by 3.05 m) mock-up for each coating system specified using same materials, tools, equipment, and procedures intended for actual surface preparation and application.
   4. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   5. Refinish mock-up area as required to produce acceptable work.
   6. Retain mock-ups to establish intended standards by which surface preparation and coating systems will be judged.

E. Pre-Application Meeting:
   1. Convene a pre-application meeting two weeks before the start of application of floor coating system.
   2. Require attendance of parties directly affecting work of this section, including the

Contractor, Architect, Owner's Representative, coating applicator, and a representative of coating material manufacturer.

3. Topics to be discussed at meeting shall include:
   a. Review of Contract Documents and accepted shop drawings and deviations or differences resolved.
   b. Review environmental conditions, surface conditions, surface preparation, application procedures, and protection after application.
   c. Review the surface preparation, application, cleaning, protection and coordination with other work.
   d. Establish areas on-site available for use as storage areas and working area.
   e. Review project schedule, and the work that should be completed before coating application.

4. Submit a written meeting report documenting the items discussed with copies to all parties attending within 3 days following the meeting.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with manufacturer's labels clearly identifying product name and manufacturer and the following:
   1. Manufacturer and Coating or material name.
   2. Color name and number.
   3. Batch or lot number.
   4. Date of manufacture.
   5. Mixing and thinning instructions.

B. Store materials in accordance with the manufacturer’s instructions.
   1. Store materials in dry, enclosed area with adequate protection from moisture.
   2. Keep containers sealed until ready for use.
   3. At all times, coatings shall be protected from freezing.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

D. Handling: Protect materials during handling and application to prevent damage or contamination

1.7 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.

C. Schedule coating work to avoid excessive dust and airborne contaminants. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.9 COORDINATION

A. Coordinate Work with other operations to avoid damage to installed materials

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specifications are based on products of manufacturers specified. Basis of Design Manufacturer: TNEMEC Company Inc., 800-863-6321. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions in order to be considered.

2.2 MATERIALS - GENERAL REQUIREMENTS

A. Interior Performance Requirements: All Interior Coatings: Supply certified test reports verifying product performance according to the following requirements:
   1. Abrasion:
      a. Method: ASTM D 4060, CS-17 Wheel, 1,000 grams load.
   2. Adhesion:
      a. Method: ASTM D 4541
      b. Method ASTM D 3359 (Method B, Crosshatch)
   3. Fresh Water:
      a. Method: Coating system applied to SSPC-SP10 cleaned hot-rolled steel, cured 7 days prior to testing and immersed in aerated tap water at 77 degrees F.
   4. Salt Spray:
      a. Method: ASTM B 117 applied to SSPC-SP10 cleaned hot-rolled steel

B. Exterior Performance Requirements: All Exterior Coatings: Supply certified test reports verifying product performance according to the following requirements:
   1. Abrasion:
      a. Method: ASTM D 4060, CS-17 Wheel, 1,000 grams load
   2. Adhesion:
      a. Method: ASTM D 4541
      b. Method: ASTM D 3359 (Method B)
   3. Exterior Exposure:
      a. Method: Exposed at 45 degrees facing ocean
      b. Location: Atlantic Seacoast - 80-foot fence
   4. Fresh Water: (Where Applicable)
      a. Method: Coating system applied to sandblasted steel panels, cured for 7 days at 77 degrees F and immersed in tap water at 77 degrees F.
   5. Hardness:
      a. Method: ASTM D 3363 (Pencil)
   6. Humidity:
      a. Method: ASTM D 2247
   7. Salt Spray (Fog):
      a. Method: ASTM B 117
   8. Graffiti Resistance (Where Applicable):
      a. Method: The following graffiti materials applied to coating and allowed to dry for 7 days: acrylic, epoxy-ester and alkyd spray paints, crayon, lipstick, shoe polish, ball point and Markette marker. Removal first attempted with xylene, if graffiti remained then methyl ethyl ketone (MEK) was tried; if graffiti remained, spray pack Vandal Mark Remover was used.
      b. Requirement: Complete and easy removal of listed media using xylene or methyl ethyl ketone (MEK), and no dulling of the surface. Metallic zinc dust content by weight in the dry film.
   9. Metallic zinc dust content by weight in the dry film.
   10. Consumer Product Safety Act Regulations Part 1303.

2.3 COATING SYSTEMS FOR STEEL, BAR JOIST, HANDRAILS, MISCELLANEOUS METALS

INTERIOR

A. Shop Primer, Interior Exposed, Concealed:
   1. System Type: Inorganic Water-Based Epoxy Primer.
   2. Surface Preparation: SSPC-SP6/NACE 3
   3. Primer (Shop): Tnemec; Series 27WB Typoxy, DFT 4.0 to 6.0 mils (100 to 150 microns).
   4. Total DFT: 4.0 to 6.0 mils (100 to 150 microns).
   5. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

B. Extended Field Exposure of Shop Primer and/or Moderate Conditions:
   1. System Type: Epoxy/Acrylic
   2. Surface Preparation: SSPC-SP 6/NACE 3.
   3. Shop Primer: Tnemec; Series 66HS Hi-Build Epoxoline, DFT 3.0 to 5.0 mils (75 to 130 microns).
   4. First Coat:
      a. Tnemec; Series 1028 Enduratone (semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
      b. Tnemec; Series 1029 Enduratone (low semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
   5. Finish Coat:
      a. Tnemec; Series 1028 Enduratone (semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
      b. Tnemec; Series 1029 Enduratone (low semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
   6. Total DFT: 7.0 to 11.0 mils (175 to 280 microns).
   7. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

C. Interior Wet and/or Chemical Exposure, Physical Abuse: Handrails, Structural Steel, Miscellaneous Metals
   1. System Type: Epoxy.
   2. Surface Preparation: SSPC-SP 6/NACE 3.
   3. Shop Primer:
      a. Tnemec; Series 66HS Hi-Build Epoxoline, DFT 3.0 to 5.0 mils (75 to 130 microns).
   4. Finish Coat: (Field)
      a. Tnemec; Series 66HS Hi-Build Epoxoline, DFT 4.0 to 6.0 mils (100 to 150 microns).
   5. Total DFT: 7.0 to 11.0 mils (175 to 280 microns).
   6. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

2.4 COATING SYSTEMS FOR SHOP PRIMED STEEL TRIM, DOORS, WINDOWS - INTERIOR & EXTERIOR

A. Dry/Moderate:
   1. System Type: Epoxy/Acrylic
   2. Surface Preparation: SSPC-SP 6/NACE 3.
   3. Shop Primer: Tnemec; Series 66HS Hi-Build Epoxoline, DFT 3.0 to 5.0 mils (75 to 130 microns).
   4. First Coat: (Field)
      a. Tnemec; Series 1028 Enduratone (gloss), DFT 2.0 to 3.0 mils (50 to 75

microns).
b. Tnemec; Series 1029 Enduratone (low semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
5. Finish Coat: (Field)
a. Tnemec; Series 1028 Enduratone (gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
b. Tnemec; Series 1029 Enduratone (low semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
6. Total DFT: 7.0 to 11.0 mils (175 to 280 microns).
7. Color:
a. As selected by Architect from manufacturer's standard colors.
b. As indicated on the Drawings.

B. Dry to Wet/Moderate to Severe:
1. System Type: Zinc Rich/Epoxy/Urethane
2. Surface Preparation: SSPC-SP 6/NACE 3.
a. Shop Primer: Tnemec; Series 94-H20 Hydro-Zinc, DFT 2.5 to 3.5 mils (65 to 90 microns).
3. Intermediate Coat: (Field)
a. Tnemec; Series 66HS Hi-Build Epoxoline, DFT 2.0 to 3.0 mils (50 to 75 microns).
4. Finish Coat: (Field)
a. Tnemec; Series 740 UVX or Tnemec; Series 1080 Endura-Shield (gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
b. Tnemec; Series 750 UVX or Tnemec; Series 1081 Endura-Shield (semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
5. Total DFT: 6.5 to 9.5 mils (165 to 241 microns).
6. Color:
a. As selected by Architect from manufacturer's standard colors.
b. As indicated on the Drawings.

2.5 COATING SYSTEMS FOR STEEL - EXTERIOR

A. Atmospheric, Aggressive Corrosion, Coastal, UV Exposure, Chemical, Physical Abuse: Parking Garage Structures, Exterior Handrails, Ornamental & Miscellaneous Metals, and Canopy Steel.
1. System Type: Zinc/Epoxy/Waterborne Urethane.
2. Surface Preparation: SSPC-SP 6/NACE 3.
3. Shop Primer:
a. Tnemec; Series 94-H20 Hydro-Zinc, DFT 2.5 to 3.5 mils (65 to 90 microns).
4. Intermediate Coat:
a. Tnemec; Series 66HS Hi-Build Epoxoline, DFT 2.0 to 3.0 mils (50 to 75 microns).
5. Finish Coat:
a. Tnemec; Series 740 UVX or Tnemec; Series 1080 Endura-Shield (gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
b. Tnemec; Series 750 UVX or Tnemec; Series 1081 Endura-Shield (semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
6. Total DFT: 6.5 to 9.5 mils (165 to 240 microns).
7. Color:
a. As selected by Architect from manufacturer's standard colors.
b. As indicated on the Drawings.

B. Exterior Exposed Steel (Overcoat):
1. System Type: Acrylic/Polyurethane or Polycarbamide.
2. Surface Preparation: SSPC-SP 6/NACE 3.
3. Primer:

a. Tnemec; Series 118 Uni-Bond Mastic, DFT 6.0 to 8.0 mils (150 to 205 microns).
4. Finish Coat:
a. Tnemec; Series 740 UVX (gloss), DFT 2.0 to 3.0 mils ((50 to 75 microns).
b. Tnemec, Series 750 UVX (semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
5. Total DFT: 8.0 to 11.0 mils (200 to 280 microns).
6. Color:
a. As selected by Architect from manufacturer's standard colors.
b. As indicated on the Drawings.

2.6 COATING SYSTEMS FOR CONCRETE AND MASONRY - INTERIOR

A. Moderate/Dry Conditions
1. System Type: (Acrylic/Acrylic)
2. Surface Preparation:
a. Concrete: SSPC-SP 13/NACE 6.
3. Filler/Surfacer (Dense CMU):
a. CMU - Tnemec; Series 130 Envirofill, 85 to 115 square feet per gallon.
b. CMU - Tnemec, Series 1254 EpoxoBlock WB, 100 to 150 square feet per gallon.
4. Primer Coat:
a. Tnemec; Series 1026 Enduratone, DFT 2.0 to 3.0 mils (50 to 75 microns).
5. Finish Coat:
a. Tnemec; Series 1026 Enduratone (matte), DFT 2.0 to 3.0 mils (50 to 75 microns).
6. Total DFT: 4.0 to 6.0mils (100 to 150 microns) over block filler.
7. Color:
a. As selected by Architect from manufacturer's standard colors.
b. As indicated on the Drawings.

B. Moderate/Dry Conditions, Physical Contact and/or Abuse:
1. System Type: (Epoxy/Epoxy/Urethane)
2. Surface Preparation:
a. Concrete: SSPC-SP 13/NACE 6.
3. Filler/Surfacer: (Dense CMU)
a. CMU - Tnemec; Series 130 Envirofill, 85 to 115 square feet per gallon.
b. CMU - Tnemec, Series 1254 EpoxoBlock WB, 100 to 150 square feet per gallon.
4. Primer Coat:
a. Tnemec; Series 280 Tneme-Glaze, DFT 6.0 to 8.0 mils (150 to 205 microns).
5. Intermediate:
a. Tnemec; Series 297 Enviro-Glaze, DFT 2.0 to 3.0 mils (50 to 75 microns).
6. Finish Coat:
a. Tnemec; Series 297 Enviro-Glaze (gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
7. Total DFT: 10.0 to 14.0 mils (250 to 360 microns) over block filler.
8. Color:
a. As selected by Architect from manufacturer's standard colors.
b. As indicated on the Drawings.

C. Moderate to Severe Conditions, Physical Contact and/or Abuse, Public Areas or Preparation Areas Frequently Cleaned or Wet.
1. System Type: 100 percent solids epoxy.
2. Surface Preparation: SSPC-SP 13/NACE 6.
a. Concrete: Abrasive blast.
3. Block Filler - CMU Only (Dense CMU): Tnemec; Series 130 Envirofill, 85 to 115 square feet per gallon.

4. First Coat:
   a. Tnemec; Series 280 Tneme-Glaze, DFT 6.0 to 8.0 mils (150 to 205 microns).
5. Finish Coat:
   a. Tnemec; Series 280 Tneme-Glaze (gloss), DFT 6.0 to 8.0 mils (150 to 205 microns).
6. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

D. Severe, Physical Contact, Wet, Bathrooms, Showers:
1. System Type: Spray-On Epoxy Fiber Glass.
2. Surface Preparation: SSPC-SP 13/NACE 6. Abrasive blast.
   a. Concrete: Abrasive blast.
3. Primer/Surfacer:
   a. Concrete - Tnemec; Series 201 Epoxoprime, DFT 6.0 to 8.0 mils (150 to 205 microns).
   b. CMU - Tnemec; Series 130 Envirofill 85 to 115 square feet per gallon.
4. Intermediate Coat:
   a. Tnemec; Series 270 Stranlok, DFT 25.0 to 40.0 mils (635 to 1020 microns).
5. Finish Coat: (Sand entire surface to remove any protruding fiberglass strands).
   a. Tnemec; Series 280 Tneme-Glaze (gloss), DFT 6.0 to 8.0 mils (150 to 205 microns).
6. Total DFT: 37.0 to 56.0 mils (900 to 1430 microns).
7. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

E. Severe, Physical Contact, Wet, Bathrooms, Showers:
1. System Type: Matte Lay-up/Epoxy Fiber Glass.
2. Surface Preparation: SSPC-SP 13/NACE 6. Abrasive blast.
   a. Concrete: Abrasive blast.
3. Primer/Block filler Coat:
   a. Tnemec; Series 201 Epoxoprime, DFT 6.0 to 8.0 mils (150 to 205 microns) (Concrete).
   b. Tnemec; Series 215 Surfacing Epoxy 40 to 50 square feet per gallon (CMU Only: to fill porosity and mortar joints).
4. Intermediate Coat:
   a. Tnemec; Series 273 Stranlok ML, DFT 12.0 to 16.0 mils (305 to 410 microns).
   b. Tnemec; Series 273-0273C Glass Mat, lay mat into wet film.
5. Saturate Coat:
   a. Tnemec; Series 280 Tneme-Glaze, DFT 12.0 to 16.0 mils (305 to 410 microns).
6. Finish Coat:
   a. Tnemec; Series 280 Tneme-Glaze (gloss). DFT 6.0 to 8.0 mils (150 to 205 microns).
7. Total DFT: 37.0 to 56.0 mils (900 to 1430 microns).
8. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

2.7 COATING SYSTEMS FOR CONCRETE AND MASONRY EXTERIOR

A. Mild to Severe Exposure
1. System Type: Water-Based Modified Acrylate.
2. Surface Preparation: SSPC-SP13/NACE 6, Clean and Dry.
3. Block Filler; Series 130 Envirofill 85 to 115 square feet per gallon.
4. Primer:
   a. Series 156 Enviro-Crete, DFT 4.0 to 8.0 mils (100 to 205 microns).

b. Series 157 Enviro-Crete, DFT 6.0 to 9.0 mils (150 to 230 microns).

5. Finish Coat:
   a. Series 156 Enviro-Crete (smooth/matte), DFT 4.0 to 8.0 mils (100 to 205 microns).
   b. Series 157 Enviro-Crete (sand texture/matte), DFT 6.0 to 9.0 mils (150 to 230 microns).
6. Total DFT:
   a. Series 156 Enviro-Crete (smooth/matte), DFT 8.0 to 16.0 mils (205 to 410 microns) over block filler
   b. Series 157 Enviro-Crete (sand texture), DFT 12.0 to 18.0 mils (300 to 460 mils) over block filler.
7. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

2.8 COATING SYSTEMS FOR CONCRETE FLOORS

A. Moderate Service and Traffic:
   1. System Type: 100% Solids Epoxy.
   2. Surface Preparation: SSPC-SP 13/NACE 6. Shot blast or mechanically abrade.
   3. Primer:
      a. Tnemec; Series 201 Epoxoprime, DFT 10.0 to 12.0 mils (250 to 305 microns).
   4. Intermediate Coat:
      a. Tnemec; Series 280 Tneme-Glaze, DFT 6.0 to 8.0 mils (150 to 205 microns).
      b. Tnemec; Series 281 Tneme-Glaze (gloss), DFT 6.0 to 8.0 mils (150 to 205 microns).
   5. Finish Coat:
      a. Tnemec; Series 280 Tneme-Glaze (gloss/orange peel), DFT 6.0 to 8.0 mils (150 to 205 microns).
      b. Tnemec; Series 281 Tneme-Glaze, DFT 6.0 to 8.0 mils (150 to 205 microns).
   6. Total DFT: 22.0 to 28.0 mils (550 to 715 microns).
   7. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

B. Moderate to Heavy Service, Areas Frequently Wet:
   1. System Type: Aggregate-filled epoxy laminate.
   2. Surface Preparation: SSPC-SP 13/NACE 6. Shot blast or mechanically abrade.
   3. Primer:
      a. Tnemec; Series 201 Epoxoprime, DFT 6.0 to 8.0 mils (150 to 205 microns).
   4. Intermediate Coat:
      a. Tnemec; Series 237 Power-Tread, double broadcast, DFT 1/8 inch (125 mils or 3,176 microns).
   5. Finish Coat:
      a. Tnemec; Series 280 Tneme-Glaze (gloss/orange peel), DFT 8.0 to 12.0 mils (200 to 305 microns).
   6. Total DFT: 1/8 inch Nominal Thickness system
   7. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

C. Moderate Service, Wet Areas, Decorative, Locker Rooms:
   1. System Type: Ceramic-filled epoxy laminate.
   2. Surface Preparation: SSPC-SP 13/NACE 6. Shot blast or mechanically abrade.
   3. Primer:
      a. Tnemec; Series 201 Epoxoprime DFT 6.0 to 8.0 mils (150 to 205 microns).

4. Intermediate Coat:
   a. Tnemec; Series 222-Colored Quartz Deco-Tread, double broadcast, DFT 1/8 inch (125 mils or 3,176 microns) (3 mm).
   b. Tnemec; Series 224 Deco-Flake, double broadcast, DFT 1/8 inch (125 mils or 3,176 microns) (3 mm).
5. Intermediate Color:
6. As selected by Architect from manufacturer's standard colors
7. As indicated on the Drawings.
8. Finish Coat:
   a. Tnemec; Series 284 Deco-Clear (clear), DFT 8.0 to 10.0 mils (205 to 250 microns).
9. Total DFT: 1/8 inch nominal thickness system
10. Color: Colored Quartz and Clear.
    a. As selected by Architect from manufacturer's standard colors.
    b. As indicated on the Drawings.

2.9 COATING SYSTEMS FOR GALVANIZED STEEL AND NON-FERROUS METAL - INTERIOR

A. Overhead Deck, Ductwork, Conduit, Dry: Moderate to Severe, Damp: Natatoriums, Warehouses.
   1. System Type: Self Cross-linking Hydrophobic Acrylic.
   2. Surface Preparation: ASTM D 6386 Abrasive Blast or Zinc Phosphate Treatment for Galvanized Steel.
   3. Primer: Must be applied within one hour after surface preparation
   4. Primer:
      a. Tnemec; Series 115 Uni-Bond DF, DFT 2.0 to 3.0 mils (50 to 75 microns).
   5. Finish Coat:
      a. Tnemec; Series 115 Uni-Bond DF(eggshell), DFT 2.0 to 3.0 mils (50 to 75 microns).
   6. Total DFT: 4.0 to 6.0 mils (100 to 150 microns).
   7. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

2.10 COATING SYSTEMS FOR GALVANIZED STEEL AND NONFERROUS METALINTERIOR OR EXTERIOR

A. Moderate Conditions and/or UV Exposure:
   1. System Type: Polyamidoamine Epoxy/Waterborne Urethane.
   2. Surface Preparation: ASTM D 6386 Abrasive Blast or Zinc Phosphate Treatment for Galvanized Steel.
   3. Primer: Must be applied within one hour after surface preparation.
      a. Tnemec; Series 66HS Hi-Build Epoxoline, DFT 3.0 to 5.0 mils (75 to 125 microns).
   4. Finish Coat:
      a. Tnemec; Series 740 UVX or Tnemec; Series 1080 Endura-Shield (gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
      b. Tnemec; Series 750 UVX or Tnemec; Series 1081 Endura-Shield (semi-gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
   5. Total DFT: 5.0 to 8.0 mils (125 to 205 microns).
   6. Color:
      a. As selected by Architect from manufacturer's standard colors.
      b. As indicated on the Drawings.

2.11 COATING SYSTEMS FOR CEMENT BOARD, GYPSUM BOARD AND CEMENT PLASTERINTERIOR

A. Dry/Moderate/Scrubbable:
1. System Type: Waterborne Epoxy-Amine Adduct/Ceramic-Modified Waterborne Aliphatic Polyurethane.
2. Surface Preparation: Clean and Dry
3. Primer:
   a. Tnemec; Series 287 Enviro-Glaze, DFT 2.0 to 3.0 mils (50 to 75 microns).
4. Intermediate Coat:
   a. Tnemec; Series 287 Enviro-Glaze, DFT 2.0 to 3.0 mils (50 to 75 microns).
5. Finish Coat:
   a. Tnemec; Series 297 Enviro-Glaze (gloss), DFT 2.0 to 3.0 mils (50 to 75 microns).
6. Total DFT: 6.0 to 9.0 mils (150 to 230 microns)
7. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

B. Wet, Moderate, Severe:
1. System Type: 100% Solids Amine Epoxy.
2. Surface Preparation: Clean and dry.
3. Primer:
   a. Tnemec; Series 201 Epoxoprime, DFT 2.0 to 4.0 mils (50 to 100 microns). (Two coats required on gypsum board)
4. Intermediate Coat:
   a. Tnemec; Series 280 Tneme-Glaze, DFT 2.0 to 4.0 mils (50 to 100 microns).
5. Finish Coat:
   a. Tnemec; Series 280 Tneme-Glaze, DFT 2.0 to 4.0 mils (50 to 100 microns).
6. Total DFT: 6.0 to 12.0 mils (150 to 300 microns) or 8.0 to 16.0 (205 to 410 microns) for Gypsum Board.
7. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

C. Severe, Physical Contact, Wet, Bathrooms, Showers:
1. System Type: Matte Lay-up/Epoxy Fiber Glass.
2. Surface Preparation: Clean and dry.
3. Joints: Finish and feather using Tnemec; Series 215 Surfacing Epoxy per manufacturer's recommendations.
4. Primer Coat:
   a. Tnemec; Series 201 Epoxoprime, DFT 6.0 to 8.0 mils (150 to 205 microns)
5. Intermediate Coat:
   a. Tnemec; Series 273 Stranlok ML, DFT 12.0 to 16.0 mils (300 to 410 microns).
   b. Tnemec; Series 273-0273C Glass Mat, lay mat into wet film.
6. Saturate Coat:
   a. Tnemec; Series 280 Tneme-Glaze, DFT 12.0 to 16.0 mils (300 to 410 microns).
7. Finish Coat:
   a. Tnemec; Series 280 Tneme-Glaze (gloss), DFT 6.0 to 8.0 mils (150 to 205 microns).
8. Total DFT: 37.0 to 56.0 mils (900 to 1,410 microns).
9. Color:
   a. As selected by Architect from manufacturer's standard colors.
   b. As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify substrate surfaces are ready to receive work as instructed by coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. General: Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Surface Preparation Of Steel
1. Prepare steel surfaces in accordance with manufacturer's instructions.
2. Fabrication Defects:
   a. Correct steel and fabrication defects revealed by surface preparation.
   b. Remove weld spatter and slag.
   c. Round sharp edges and corners of welds to a smooth contour.
   d. Smooth weld undercuts and recesses.
   e. Grind down porous welds to pinhole-free metal.
   f. Remove weld flux from surface.
3. Ensure surfaces are dry.
4. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3, unless otherwise specified.
5. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
6. Shop Primer: Prepare shop primer to receive field coat in accordance with manufacturer's instructions.

C. Surface Preparation Of Concrete And Masonry
1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
2. Concrete Masonry Units: Allow concrete and mortar to cure 28 days. Surfaces must be clean, dry, and free of oil, grease and other contaminants. Level protrusions and mortar spatter. Voids and other defects should be filled with recommended filler or surfacer.
3. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
4. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
5. Allow concrete and mortar to cure for a minimum of 28 days before coating.
6. Level protrusions and mortar spatter.

D. Surface Preparation Of Wood
1. Ensure wood surfaces are clean and dry, and free of dust, dirt and other contaminants.
2. Remove surface deposits, sap or pitch by scraping and wiping clean with rags dampened with mineral spirits or VM&P Naphtha.
3. Seal knots and pitch pockets with shellac reduced with equal parts of shellac thinner (denatured alcohol) before priming.
4. Sand rough spots with the grain, starting with medium grit sandpaper and finishing with fine grit. Remove sanding dust.
5. After the prime coat is dry, fill cracks and holes with a suitable compound that is compatible with the substrate and coating. When filler is hard, sand flush with the surface using the fine grit sand paper.

6. Sand lightly between coats with fine grit, open-coat sandpaper.

E. Surface Preparation Of Stucco And Plaster
1. Prepare stucco and plaster surfaces in accordance with manufacturer's instructions.
2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
3. Allow stucco and plaster to cure and dry out for a minimum of 14 days before coating.
4. Do not coat over stucco or plaster containing free water, lime, or other soluble alkaline salts.
5. Remove plaster nibs and other protrusions.
6. Patch voids and cracks with approved materials and after dry, sand flush with surface

F. Surface Preparation Of Galvanized Steel And Nonferrous Metal
1. Prepare galvanized steel per SSPC-SP16.
2. Prepare nonferrous metal surfaces in accordance with manufacturer's instructions. Surface preparation recommendations will vary depending on substrate and exposure conditions.

G. Surface Preparation Of Gypsum Board
1. Prepare gypsum board surfaces in accordance with manufacturer's instructions.
2. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
3. Sand joint compound smooth and feather edge.
4. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.
5. Do not apply putty, patching pencils, caulking, or masking tape to gypsum board surfaces to be painted.
6. Lightly scuff-sand tape joints after priming to remove raised paper nap. Do not sand through primer.

3.3 APPLICATION

A. Apply coatings in accordance with manufacturer's instructions.

B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.

C. Keep containers closed when not in use to avoid contamination.

D. Do not use mixed coatings beyond pot life limits.

E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.

F. Uniformly apply coatings at spreading rate required to achieve specified DFT.

G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

H. Apply primer as recommended for the application. Components shall be pre-mixed, blended, and applied according to manufacturer's directions.

I. Components for subsequent coats shall be mixed and applied in strict accordance with manufacturer's directions.

3.4 FIELD QUALITY CONTROL

A. Inspector's Services: Coordinate with Independent Inspection Services provided by the

Owner as specified in Section 01 45 16.13 - Contractor Quality Control. Services include:

1. Coordinate with coating manufacturer's technical service department or independent sales representative for current technical data and instructions.
2. Verify suitability of moisture vapor emission rate of concrete floor surfaces.
3. Verify coatings and other materials are as specified.
4. Verify surface preparation and application is as specified.
5. Verify DFT of each coat and total DFT of each coating system specified using wet film and dry film gauges.
6. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
7. Report:
    a. Submit daily written reports describing inspections made and actions taken to correct non-conforming work.
    b. Report non-conforming work not corrected.
    c. Submit copies of report to Architect and Contractor.

B. Coating manufacturer's representative to verify that installation is in conformance to the manufacturer's recommendations.

3.5 CLEANING

A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.6 REPAIR

A. Materials and Surfaces Not Scheduled to be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair of damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.

C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.7 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

D. Protect installed products until completion of project.

E. Touch-up, repair or replace damaged products before Substantial Completion.

F. Remove temporary coverings and protection of surrounding areas and surfaces.

END OF SECTION 09 96 00

SECTION 09 97 23 - CONCRETE AND MASONRY COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Application of membrane type curing and sealing compound on concrete surfaces to remain exposed.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

A. Application of membrane type curing and sealing compound on concrete surfaces to remain exposed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean, dry area in accordance with manufacturer's instructions.

C. Keep product from freezing.

D. Avoid direct contact with this product as it may cause mild-to-moderate irritation of the eyes and/or skin.

E. Protect materials during handling and application to prevent damage or contamination.

F. Do not mix any compound containing solvent.

G. Do not mix or agitate aggressively as foaming can occur.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Basis of Design: “Vocomp-20” as manufactured by W.R. Meadows, Inc. or comparable product approved by Architect. Other manufacturers must have a minimum of five (5) years’ experience manufacturing products meeting or exceeding the specifications, comply with Division 1 requirements regarding substitutions to be considered and have Architect’s approval prior to its use on the Project.
   1. Dayton-Superior Corp.

2. Euclid Chemical Company.

2.2 MATERIALS

A. Typical, except as noted: Membrane type curing and sealing compound conforming to ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Type I, Class B and complying with Sealtight "Vocomp-20" as manufactured by W.R. Meadows, Inc., Fort Worth, TX; (817) 834-1969 or comparable product approved by the Architect.

B. Exterior Non-slip Traffic Coating: “Vocomp-20" as specified above, with “Sure-Step” slip-resistant additive as manufactured by W.R. Meadows, Inc., Fort Worth, TX; (817) 834-1969 or comparable product approved by the Architect.

C. Interior: (**CS-1**) - Eucosil by The Euclid Chemical Company or comparable product approved by the Architect

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive curing and sealing compound. Notify architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive curing and sealing compound.

B. Clean and prepare surfaces to receive curing and sealing compound in accordance with manufacturer's instructions.

C. Ensure concrete surface is clean and dry, with all stains, oil, grease, dust, and dirt removed.

D. Concrete surface water should be dissipated when used on new concrete.

E. Concrete surfaces should not be marred by walking workers.

3.3 APPLICATION

A. Apply curing and sealing compound in accordance with manufacturer's instructions.

B. Ensure product is mixed for optimum performance. Avoid aggressive mixing as foaming may occur.

C. Use an industrial sprayer with a 5916 tip that produces a flow rate of 1/10 of one gallon per minute under 0.276 MPa (40 psi) of pressure.

D. Spray on in a fine, fog pattern, without spurts and dribbles, to form a thin, continuous film.

E. Alternatively apply using a lint-free roller or lamb’s wool roller.

F. Avoid puddling in low areas.

END OF SECTION 09 97 23

SECTION 10 14 00 – GRAPHICS

PART 1 - GENERAL INSTRUCTIONS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Panel signs.
   2. Room identification signs.
   3. Field applied, vinyl character signs.
   4. Cast character for exterior signage.
   5. Illegally Parking Signs in Accessible Spaces.
   6. Dedication plaque.
   7. Lit Reverse Channel Letter Sign.
   8. Face Lit Channel Letter Sign
   9. Accessories necessary for a complete installation.

B. Allowance: Signage is affected by allowances. Refer to Section 01 21 00.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of signage

B. Signage Shop Drawings: Submit fabrication and installation details and attachments to other Work.
   1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Dedication Plaque Shop Drawings: Submit fabrication and installation details and attachments to other Work.
   1. Indicating materials, sizes, and finishes, details of fabrication and installation, fasteners and hardware, attachments, related and adjacent Work.
   2. Rubbing of actual pattern of cast metal plaque for Architect’s approval prior to casting.

D. Certifications: Submit letter of certification from manufacturer that installer and manufacturer is in compliance and meets specified requirements.

E. Samples:
   1. One (1) 6 inch x 6 inch sample of cast metal plaque material with specified finish.
   2. One (1) 6 inch x 6 inch sample of colored elements will be required if specific colors are needed in lit signage

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Building Code/City Code: Comply with building code and local ordinances for exterior signage.
2. Accessibility Requirements: Comply with applicable requirements.
   a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
   b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
   c. Texas Accessibility Standards (TAS) 2012.

B. Installer Qualifications: Installer has minimum 5 Years documented experience in the manufacture of signage and who employs installers and supervisors trained and approved in installation methods for each type of signage.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.6 WARRANTY

A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image.
      c. Separation or delamination of sheet materials and components.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design Manufacturer: Riot Creative Imaging; (713) 988-9200. Other manufacturers shall have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified and shall comply with Division 1 requirements for substitutions in order to be considered.
   1. South Texas Graphics; (713) 467-4499
   2. A.R.K. Ramos Architectural Signage Systems; (405) 235-5505.
   3. InPro Corporation (IPC); (800) 222-5566.
   4. ProWorx Architectural Signage; (713) 666-3131.
   5. The Southwell Co.; (210) 223-1831.

B. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

C. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

E. Acrylic Sheet: ASTM D 4802, category standard with manufacturer for each sign, Type UVF (UV filtering).

F. Plastic Laminate Sheet: NEMA LD 3, general purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

G. Vinyl Film: UV resistant vinyl film of nominal thickness indicated, with pressure sensitive, permanent adhesive on back; die cut to form characters or images indicated and suitable for exterior applications.

H. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

I. Accessories:
   1. Fasteners and Anchors: As necessary for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
      a. Use concealed fasteners and anchors unless indicated to be exposed.
      b. Exposed Metal Fastener Components: Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   2. Sign Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
   3. Adhesive: Recommended by sign manufacturer.
   4. Two Face Tape: High bond, foam core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
   5. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187.

2.2 SIGNAGE

A. GENERAL
   1. If Acrylic is designated in drawings: Constructed of one (1) layer of ¼” acrylic in color(s) specified in drawings by Architect / Owner
   2. If Laminate is specified in drawings: Constructed of one (1) or two (2) high pressure laminate in colors selected by Architect / Owner, laminated to an 1/8” inch thick acrylic backer.
   3. Signage shall have radius or square corners with square cut edges painted a color (as needed) as selected by Architect / Owner.
   4. Demarcation lines, if any, can be raised 1/32” inch to match copy or engraved and infilled with a color as selected by Architect / Owner.
   5. Signs shall comply with all state and federal codes, including but not limited to, the 2012 ADA and TAS requirements.
   6. Refer to drawings for details of types, dimensions, colors, graphic layouts and mounting/height specifications.

B. Room Numbers, Symbols, Lower or Secondary Copy, and Pictograms:
   1. Copy shall be matte finished acrylic, raised /32” inch of a color contrasting to the face laminate or acrylic.
   2. Characters and pictograms shall be chemically welded to the acrylic backing to assure permanent adhesion.
   3. Room numbers and restroom copy shall be copy shall be accompanied by Grade II Braille by means of ‘VisiTouch DuraDot System’. Glass or metallic ‘DuraDots’ shall have .059

inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.

4. Secondary copy shall be a minimum of 5/8" inch high, matte finished acrylic, raised 1/32" inch san serif font.
5. Acceptable ADA compliant fonts are Arial, Helvetica, Optima, Futura or other Font as selected by Architect (if ADA compliant), in all caps.

C. Restroom Pictograms:
1. Pictograms shall appear on a minimum 6" inch, unobstructed square.

D. Window (Slotted) Signs:
1. Window / Slotted signs shall be open at both ends for changeable insert provided by Owner. Window shall be a non-glare Lexan acrylic lens, with an exposed color laminate behind in color as selected by Architect/Owner.

E. Fasteners and Accessories:
1. 1/8" inch thick, double-sided foam tape of type recommended to suite application and commercial grade silicone sealant.
2. Back-up plates shall be supplied, when shown or required, for signage mounted on glass

F. Provide all materials required for a complete installation.

G. Approved manufacturers:

1. Signage:
   a. Refer to 2.1.A. of Section 10 14 00 for approved manufacturers.
2. Plastic Laminate:
   a. WilsonArt International, Temple, TX 800.433.3222
   b. Nevamar Company, LLC, Shelton, CT 877.726.6526
   c. Formica, 1.800.367.6422
   d. Pionite, Shelton, CT 203.925.1556
3. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles:
   a. Character Material: Cast aluminum.
   b. Character Height: Indicated on Drawings.
   c. Finishes:
      1) Baked Enamel or Powder Coat Finish: Color to match school colors and logo.
      2) Overcoat: Baked on clear coating.
   d. Mounting: Concealed studs.
   e. Typeface: Selected by Architect.
4. Field Applied, Vinyl Character Sign: Prespaced characters die cut from 3 mil to 3.5 mil (0.076 mm to 0.089 mm) thick, weather resistant vinyl film with release liner on the back and carrier film on the front for on site alignment and application.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Allen Markings.
      2) APCO Graphics, Inc.
      3) Mohawk Sign Systems.
      4) Seton Identification Products.
   b. Size: Indicated on Drawings.
   c. Substrate: Indicated on Drawings.
5. Lit Reverse Channel Letter Sign :
   a. Basis of Design : Riot Creative Imaging, Aria Signs or comparable product approved by Architect.
   b. Type: Back lit.

c. Character Material: Cast aluminum.
d. Character Height: Indicated on Drawings.
e. Mounting: Mounted on raceway.
f. Finishes:
1) Baked Enamel or Powder Coat Finish: Color to match school colors and logo.
2) Overcoat: Baked on clear coating.

6. Face Lit Channel Letter Sign :
a. Basis of Design : Riot Creative Imaging, Aria Signs or comparable product approved by Architect.
b. Type: Interior Lit LED
c. Character Material: Cast aluminum.
d. Face Material: Indicated on drawings
e. Character Height: Indicated on Drawings.
f. Mounting: Indicated on Drawings.
g. Finishes:
1) Baked Enamel or Powder Coat Finish: Color to match school colors and logo.
2) Overcoat: Baked on clear coating.

7. Illegally Parking Signs in Accessible Spaces:
a. Sign for Illegally parking in a paved accessible parking space.
b. Minimum state “Violaters Subject to Fine and Towing” in a letter height of at least one inch.
c. Mounted on a pole, post, wall or freestanding board as shown on the Drawings.
d. No more than eight (8) inches below a sign required by ADA and TAS standards.
e. Installed so bottom edge of sign is no lower than 48 inches and no higher than 80 inches above ground level.

2.3 DEDICATION PLAQUE

A. Cast Metal Dedication Plaque:
1. Material and Fabrication:
a. Casting: Prime bronze ingots of Alloy 220 Commercial bronze free of pits and gas holes and all letters shall be sharp and hand tooled.
b. Border Style: Single line standard border design.
c. Letter Style/Sizes: Shall be Helvetica Medium in both upper and lower case letters, unless shown otherwise. Letter sizes shall be as shown on drawings.
d. Finishes:
1) Borders and Letter Faces: satin finish.
2) Plaque Background: Pebble texture finish with baked on acrylic coating.
3) Plaque shall be chemically cleaned.
4) Completed plaque shall be sprayed with two (2) coats of clear hardened acrylic polyurethane.
e. Size: As shown on drawings.
2. Fasteners and Attachment Hardware: Concealed fasteners and hardware of size and type recommended by manufacturer for attachment of plaque on brick wall where indicated on drawings.
3. Provide all materials required for a complete installation.
4. Basis of Design: South Texas Graphics; (713) 467-4499.
5. Other Approved Manufacturers:
a. A.R.K. Ramos Architectural Signage Systems, Oklahoma City, OK; (405) 235-5505
b. Best Manufacturing Sign Systems, Montrose, CO; (800) 235-2378
c. York Bronze Company, Bryan, TX; (800) 488-4662
d. Gemini Incorporated, Cannon Falls, MN; (800) 538-8377
e. Matthews Bronze, Pittsburgh, PA; (800) 950-1317
f. Metal Arts, Division of L & H Mfg. Co., Mandan, ND; (800) 237-8069
g. ProWorx Architectural Signage, Houston, Texas; (713) 666-3131

h. The Southwell Co., San Antonio, TX; (210) 223-1831 (Basis of Specification)

2.4 FABRICATION

A. Provide sign assemblies according to requirements indicated.
1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing Work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket mounted signs to suit sign construction and mounting conditions indicated. Modify brackets as necessary.
1. Aluminum Brackets: Factory finish brackets with baked enamel or powder coat finish to match sign background color color unless otherwise indicated.

2.5 FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

E. Aluminum Finishes:
1. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
2. Baked Enamel or Powder Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of signage Work. Verify sign support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Install signs so they do not protrude or obstruct according to the accessibility standard.
   3. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
      a. Comply with all applicable accessibility requirements for mounting height and location of each sign.
   4. Before installation, verify sign surfaces are clean and free of materials or debris that impair installation.
   5. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
   1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
      a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
      b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
   2. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
   3. Shim Plate Mounting: Provide 1/8 inch (3 mm) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.

C. Field Applied, Vinyl Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

E. Cast Metal Dedication Plaque:
   1. Install in accordance with manufacturer’s instructions.
   2. Install in location shown on drawings.

3. Install with concealed fasteners of threaded bolt screwed into back of plaque and inserted into hole drilled in brick at an angle and filled with cement.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

THIS PAGE INTENTIONALLY LEFT BLANK

TOMBALL ISD

MULTI-PROGRAM ACTIVITY CENTERS

GRAPHIC PACKAGE 1
OCOTBER 30, 2026

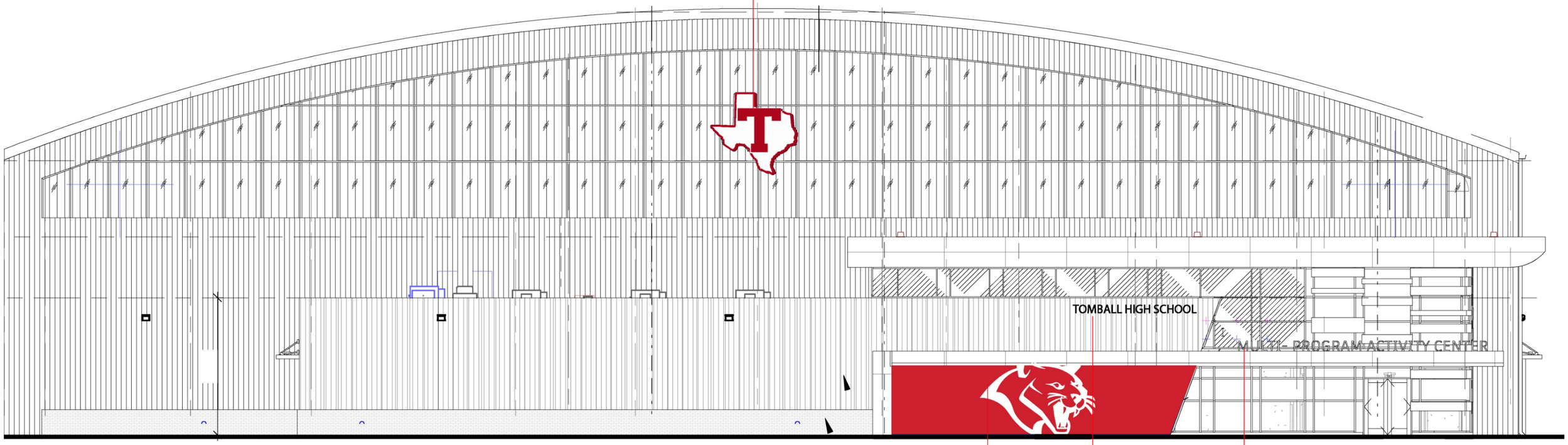
PBK



EXTERIOR

TOMBALL MPAC// TOMBALL ISD

CHANNEL LOGO 11’12’w x 10’5”h
FRONT FACE: ACRYLIC
RETURN:3”DEEP PAINTED ALUMINUM
ADD DRAIN HOLES
INTERNALLY LIT



PAINTED LOGO (EXTERIOR GRADE PAINT)

“MUTLI PROGRAM ACTIVITY CENTER”
1’ 4” TALL CHANNEL LETTERING
FRONT FACE: WHITE PAINTED ALUMINUM
(EXTERIOR RATED PAINT)
RETURN:2” DEEP WHITE PAINTED ALUMINUM
ADD DRAIN HOLES
BACKLIT

“TOMBALL MEMORIAL HIGH SCHOOL”
1’ TALL CHANNEL LETTERING
FRONT FACE: WHITE PAINTED ALUMINUM (EXTERIOR RATED PAINT)
RETURN:2” DEEP WHITE PAINTED ALUMINUM
ADD DRAIN HOLES
INTERNALLY LIT

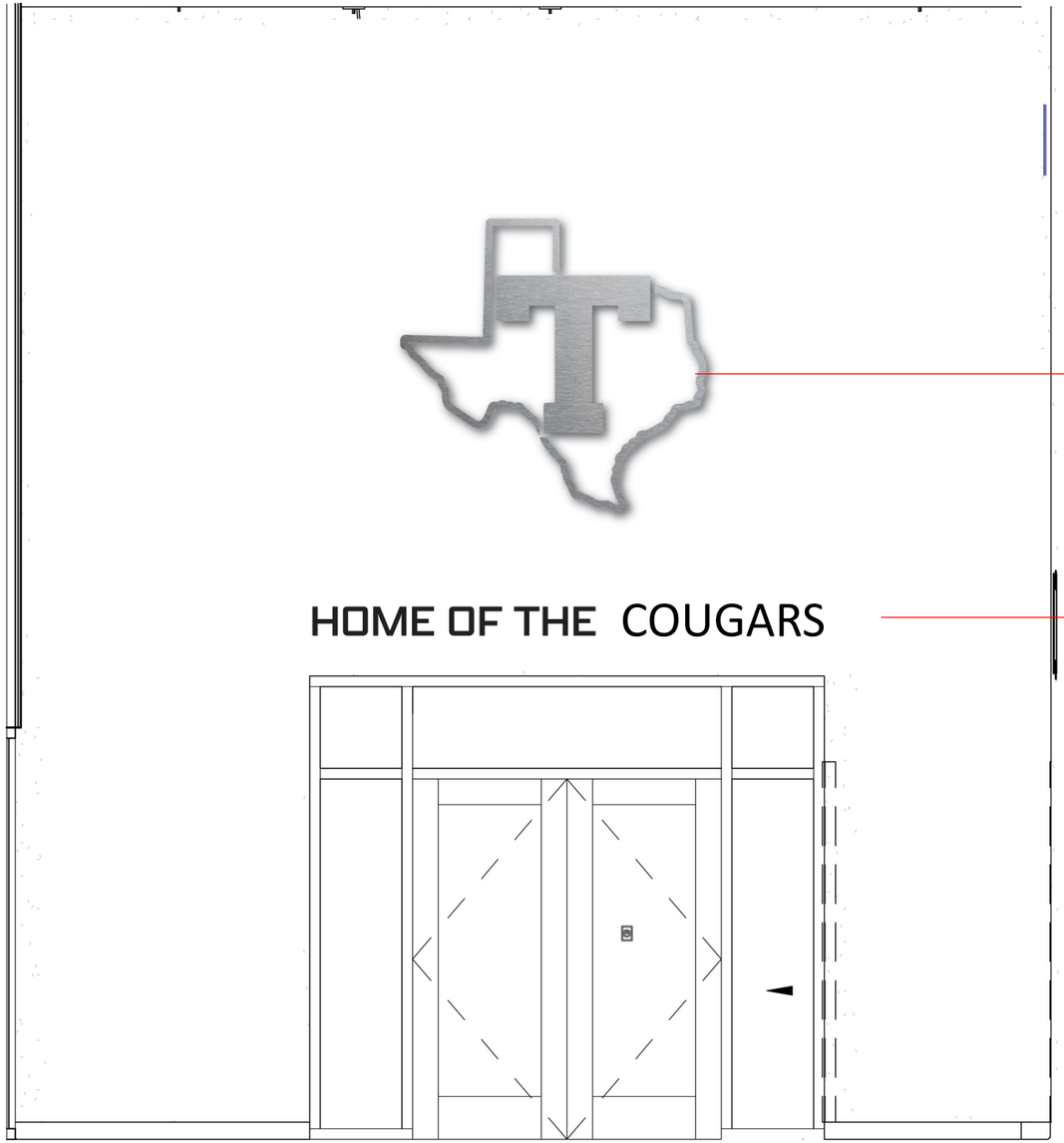
EXTERIOR TOMBALL HIGH SCHOOL

TOMBALL MPAC// TOMBALL ISD



RENDERING - LOBBY

TOMBALL MPAC// TOMBALL ISD



BRUSHED ALUMINUM LOGO

METAL LETTERS

DIMENSIONAL ALUMINUM LOGO, FLUSH MOUNTED TO WALL
CUT METAL LETTERS – "HOME OF THE. . "

LOC B – LOBBY WEST

TOMBALL MPAC// TOMBALL ISD

SECTION 10 21 17- SOLID PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Solid Phenolic (SPC) Core toilet partitions, floor mounted, overhead braced.

1.3 SUBMITTALS

A. Shop Drawings: Within four (4) weeks of award of contract, submit:
   1. Complete shop drawings for the Architect's approval, showing all required field measurements, all details and elevations, plans and sections required to indicate all conditions.
   2. Manufacturer's installation instructions.

B. Certification: Provide a certificate of compliance attesting that all materials are in accordance with manufacturer’s specifications.

1.4 FIELD MEASUREMENTS

A. Field verify dimensions prior to submittals and fabrication.

1.5 WARRANTY

A. Furnish twenty-five year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.

B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Any one (1) of the following manufacturers whose product meets or exceeds the specifications for those specified is approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding those specified for design, size, finish, and fabrication and comply with Division 1 requirements for substitutions in order to be considered.
   1. Accurate Partitions Corporation, Lyons, IL

2. Ampco Products, Inc., Sanger, TX
3. Bobrick Washroom Equipment, Inc., North Hollywood, CA
4. Bradley Corporation, Menomonee Falls, WI
5. DesignRite Partitions (Spec-Rite Designs), St. Louis, MO
6. Flush-Metal Partition, Maspeth, NY
7. General Partitions Mfg. Corp., Erie, PA
8. Global Steel Products Corp., Deer Park, NY
9. Knickerbocker Partition Corp., Irving, TX
10. Metpar Corp., Westbury, NY
11. Columbia Partitions, a Division of PSiSC, Columbia, SC
12. Tex-Lam Manufacturing, Inc., Houston, TX

2.2 MATERIALS

A. General: Comply with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS).

B. Doors: 3/4 inch thick solid phenolic core with high pressure melamine color surface on faces. Edges shall be burnished and slightly rounded. Standard door size, other than “accessible”, is 24 inches, unless indicated otherwise.

C. Panels: 3/4inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.

D. Pilasters: Pilaster Shoes and Sleeves (Caps): Stainless steel.
1. Pilaster shall be attached to the floor by means of an 11 gauge stainless steel footer, with provisions for leveling, attached to two (2) 3/8 inch diameter stainless steel studs set into expansion shields. The floor connections are to be covered by a four (4) inch high stainless steel shoe, #4 finish.
2. Option Panels: 3/4 inch thick solid phenolic core with high pressure color surface on faces. Edges shall be burnished and slightly rounded.

E. Headrail: heavy duty aluminum extrusions, anodized with anti-grip configuration, and shall be fastened to the pilaster tops.

F. Hardware and Accessories: Heavy duty operating hardware and accessories.
1. Hinges: 16-gauge continuous piano, self-closing hinge. Continuous piano hinge shall be attached to door and stile by theft resistant, pin-in-head Torx stainless steel machine screws into factory installed, threaded brass inserts. Fasteners secured directly into the core are not acceptable.
2. Latch and Keeper: Heavy duty surface mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
3. Coat Hook: Heavy duty combination cast stainless steel hook and rubber tipped bumper, sized to prevent in swinging door from hitting compartment mounted accessories. Mount with through bolts.
4. Door Bumper: Heavy duty rubber tipped cast stainless steel bumper at out swinging doors and entrance screen doors. Mount with through bolts.
5. Door Pull: Heavy duty cast stainless steel pull at out swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.

G. Finish: Melamine color surface on material face, edges burnished. All wood grain panels larger than 57-1/4 inches will have horizontal grain.

H. Color: Shall be selected from the manufacturer's high pressure plastic laminate color chart. The colors available shall be the same as offered for plastic laminate partitions. Core shall be color-thru.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Install all toilet partitions where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for long life under hard use and in complete accordance with the manufacturer's recommendations.

C. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.

3.2 CLEANING AND ADJUSTING

A. Clean surfaces free of dirt, oil, grease and other contaminants which detract from appearance of partitions.

B. Except for compartments for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

3.3 REPLACEMENT OF DEFECTIVE MATERIALS

A. Defaced, damaged, scratched or marred materials will not be permitted, will be considered defective, and rejected. Rejected materials shall be replaced with new materials at no additional expense to Owner.

END OF SECTION 10 21 17

SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Public use washroom accessories.
   2. Private use bathroom accessories.
   3. Healthcare accessories.
   4. Warm air dryers.
   5. Underlavatory guards.
   6. Custodial accessories.
   7. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   2. Include electrical characteristics.

B. Samples: Full size, for each exposed product and for each finish specified.
   1. Approved full size Samples will be returned and may be used in the Work.

C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.

D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Accessibility Requirements: Comply with applicable requirements.
      a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
      b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
      c. Texas Accessibility Standards (TAS) 2012.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Source Limitations: Obtain products from single source from single manufacturer.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AJW Architectural Products.; (845) 562-3332.
   2. American Specialties, Inc.; (914) 476-9000.
   3. Bobrick Washroom Equipment, Inc.; (866) 960-6484.
   4. Bradley Corporation.; (262) 251-6000.
   5. Brey-Krause Manufacturing Co.; (610) 867-1401.
   6. Koala Bear Kare.; (888) 733-3456.
   7. GAMCO Specialty Accessories; a division of Bobrick.; (580) 924-8066.
   8. Tubular Specialties Manufacturing, Inc.; (800) 225-5876.
   9. World Dryer Corporation.; (800) 323-0701.

B. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

C. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

D. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

E. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot dip zinc coating.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick.

2.2 COMPONENTS

A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
   1. Material and Finish: Antimicrobial, molded plastic, white.

2.3 FABRICATION

A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 - SCHEDULE

4.1 ACCESSORY SCHEDULE

A. TA-1 - Soap Dispensers:
   1. Basis of Design: Model B-2112 as manufactured by Bobrick Washroom Equipment.
   2. Mounting: Surface.
   3. Locations: All lavatories.

B. TA-2 - Mirrors:
   1. Basis of Design: Model B-290 as a manufactured by Bobrick Washroom Equipment.
   2. Mounting: Surface.
   3. Size: 24 inches by 36 inches (600 mm by 900 mm), unless shown otherwise.
   4. Location: All lavatories.

C. TA-3 - Toilet Paper Dispensers:
   1. Basis of Design: Model B-265 as manufactured by Bobrick Washroom Equipment.
   2. Mounting: Surface.
   3. Locations: All water closets.

D. TA-4 - Paper Towel Dispensers:
1. Basis of Design: Model B-262 as manufactured by Bobrick Washroom Equipment.
2. Locations: All lavatories.

E. TA-5 - Grab Bars: (At Typical Accessible Toilet Stalls)
1. Basis of Design: Model B-6806 as manufactured by Bobrick Washroom Equipment.
2. Size/Finish: 1-1/2 inch diameter satin stainless steel.
3. Clearance: 1-1/2 inch between rail and wall.
4. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
5. Location: Accessible water closets and toilet stalls.

F. TA-8 Mop and Broom Holder:
1. Basis of Design: Model B-239 x 34 as manufactured by Bobrick Washroom Equipment.
2. Mounting: Surface.
3. Capacity: Four hooks, three mop holders.
4. Locations: Mop sink at each custodial rooms.

G. TA-11 - Clothes Hook:
1. Basis of Design: Model B-6717 as manufactured by Bobrick Washroom Equipment.
2. Mounting: Surface.
3. Locations: All shower locations.
4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.

H. TA-13 - Electric Hand Dryers:
1. Basis of Design: Model B-750, white as manufactured by Bobrick Washroom Equipment.
2. Mounting: Semirecessed, maximum 3-9/16 inch recess.
3. Voltage: 120 volt, single phase.
4. Location: Refer to drawings.

I. TA-14 - Paper Towel Dispenser/Trash Receptacle Combination
1. Basis of Design: Model B-3949 as manufactured by Bobrick Washroom Equipment.
2. Mounting: Surface.
3. Locations: Refer to drawings.

J. TA-15 - Grab Bars: (At Additional Accessible Toilet Stalls)
1. Basis of Design: Model B-6806 as manufactured by Bobrick Washroom Equipment.
2. Size/Finish: 1-1/2 inch diameter satin stainless steel, lengths as indicated in drawings.
3. Clearance: 1-1/2 inch between rail and wall.
4. Mounting: Attach with concealed mounting. Mount parallel to floor.
5. Location: Accessible water closets and toilet stalls.

K. TA-17 - Trash Receptacle
1. Basis of Design: Model B-3644 as manufactured by Bobrick Washroom Equipment.
2. Mounting: Recessed
3. Locations: Refer to drawings.

L. TA-18 – Electric, Swivel Head, Hand Dryers:
1. Basis of Design: Model DR-5708 as manufactured by GAMCO Specialty Accessories; a division of Bobrick.
2. Mounting: Surface.
3. Voltage: 115 volt, single phase.
4. Location: Refer to drawings.

END OF SECTION 10 28 13

SECTION 10 44 00 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections

1.2 SUMMARY

D. Section Includes: Requirements including but not limited to:
1. Fire extinguisher.
2. Extinguisher cabinet.
3. Defibillator (AED) Cabinet.
4. Brackets.
5. Accessories necessary for complete installation.

1.3 SUBMITTALS

D. Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection specialties.
1. Fire Extinguishers: Include rating and classification.
2. Cabinets: Include roughing in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, panel style.

1.4 QUALITY ASSURANCE

D. Regulatory Requirements:
1. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10 *Standard for Portable Fire Extinguishers*.
2. Fire Extinguisher Listing: UL listed with UL Listing Mark for type, rating, and classification of extinguisher.
3. Accessibility Requirements: Comply with applicable requirements.
   a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) 2010.
   b. ICC/ASI A117.1 *Accessible and Useable Building and Facilities.*
   c. Texas Accessibility Standards (TAS) 2012.

E. Source Limitations: Obtain fire extinguishers and fire protection cabinets through one source from a single manufacturer.

1.5 COORDINATION

D. Coordinate size of fire extinguisher cabinets to ensure that type and capacity of fire extinguishers indicated and required by the Fire Marshall are accommodated.

1.6 WARRANTY

D. Warranty: Written warranty in which manufacturer agrees to repair or replace components of portable fire extinguishers failing in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: 6 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

D. Basis of Design: Specifications are based on the Potter Roemer Alta Series fire extinguisher cabinets. Subject to compliance with requirements, provide comparable products by one of the following:
   1. Impact Fire Services, LLC.
   2. J. L. Industries, Inc.
   3. Larsen's Manufacturing Company.
   4. Nystrom, Inc.
   5. Potter Roemer LLC.

2.2 COMPONENTS

D. Fire Extinguisher: Provide fire extinguishers for each fire extinguisher cabinet and at locations indicated. Provide multipurpose dry chemical units, UL rated 4-A:80-B:C, 10 lb (4.5-kg) nominal capacity, in enameled steel container. Provide mounting brackets where necessary.

E. Cabinets: Fire rated cabinet sized for housing fire extinguishers of types and capacities indicated or required by AHJ.
   1. Cabinet Construction: Construct fire rated cabinets with double walls fabricated from 1.1mm thick, cold rolled steel sheet lined with minimum 16 mm thick, fire barrier material. Provide factory drilled mounting holes.
      a. Cabinet Metal: Steel sheet.
      b. Cabinet Mounting: Semi recessed or recessed.
      c. Cabinet Trim Style: Trimless with hidden flange of same metal and finish as box that overlaps surrounding wall finish and concealed from view by an overlapping door.
      d. Cabinet Trim Material: Steel sheet.
      e. Door Material: Tempered glass or clear acrylic.
      f. Door Style: Fully glazed, frameless, backless, tempered glass or acrylic panel.
      g. Door Construction: Fabricate doors of materials indicated and coordinated with cabinet types and trim styles selected.
      h. Door Hardware: Door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide projecting lever handle with cam action latch. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

   2. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim.
      a. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as drywall bead.

3. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation. Square edge trim, 32 mm to 38 mm backbend depth.

D. Defibrillator (AED) Cabinet (for Owner-furnished AED):
1. Basis of Design: J. L. Industries, Inc. 1400 Series steel cabinet.
2. Mounting: Fully or semi-recessed, as indicated in the drawings. Surface mounted units are not acceptable.
3. Door: Fullly glazed with acrylic glazing, continuous hinge, "AED" and symbolic heart graphics, roller catch, and plated metal handle.
4. Alarm: Battery-operated, with on/off key switch on exterior of cabinet.
5. ADAC-compliant.
6. Size: Large enough to accommodate most AEDs, but at least 14 inches x 14 inches by 7 inches deep net inside dimensions.
7. Finish: White powder coat.

E. Accessories:
1. Mounting Bracket: Steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked enamel finish.

2.3 FABRICATION

D. Fire Protection Cabinets: Standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Provide factory drilled mounting holes. Prepare doors and frames to receive locks.

E. Cabinet Doors: Fabricate doors from materials indicated and coordinated with cabinet types and trim styles selected.

F. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 FINISH

D. Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.

E. Factory Prime for Field Finish: Apply fast curing, lead and chromate free, universal primer shop primer immediately after surface preparation and pretreatment to exterior and interior of cabinet.

PART 3 - EXECUTION

3.1 PREPARATION

D. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.2 INSTALLATION

D. Comply with manufacturer's printed instructions for installation.

E. Install fire protection specialties in locations and at mounting heights indicated compliant with accessibility requirements acceptable to authorities having jurisdiction. Fasten cabinets to structure, square and plumb.

F. Fire Protection Cabinets:
1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi recessed fire protection cabinets.
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

G. Field paint fire protection cabinets to match adjacent area; color indicated in Finish Schedule.

H. Provide five (5) additional fire extinguishers to be installed at locations determined by Fire Marshall.

3.3 ADJUSTING AND CLEANING

D. Adjust cabinet doors to operate freely without binding.

E. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.

F. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

G. Touch up marred finishes or replace fire protection cabinets that cannot be restored to factory finished appearance. Use materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

H. Replace fire protection cabinets damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 00

SECTION 10 73 13 - ALUMINUM CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to
   1. Fixed canopy.
   2. Accessories necessary for a complete application.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Texas, using performance requirements and design criteria indicated.

B. System Performance: Provide canopy system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live loading, dead loading and wind loading in compliance with building code requirements:
   1. Live Load: 20 psf minimum.
   2. Structural Design for Wind Forces: Comply with ANSI A58.1.
   3. Base Mean Wind Velocity: 120 mph, Exposure Classification C.
   4. Importance Factor: 1.0.
   5. Stability Criteria: Comply with applicable building codes.
   6. Design structural members to meet minimum deflection criteria of L/180.
   7. Design footings for maximum bearing pressure of 1,500 psf.

C. Provide structure capable of sustaining severe icing, hail, hurricane force winds and supporting concentrated load such as being walked upon.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, specifications, component performance data and installation instructions.

B. Shop Drawings: Submit detailed drawings, layout of canopy system, bent locations, mechanical joint locations with complete details, connections, jointing and accessories. Include details of tube anchorage.

C. Samples: Color charts showing full range of colors.

D. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible in the jurisdiction of the project, for their preparation.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Building Code: International Building Code.
2. AWS (American Welding Society) standards for structural aluminum welding.

B. Installer Qualification: Firm with not less than 5 years experience in installation of aluminum sunshades of type, quantity and installation methods similar to work of this section.

C. Source Limitations: Obtain aluminum covered walkway system from single source.

D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of work.

E. Allow for adjustments within specified tolerations wherever taking of field measurements before fabrication might delay work.

F. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

G. Coordination: Coordinate work of this section with work of other sections which interface with sunshade system (building structure, building finishes, etc.).

1.6 CONTRACTOR'S RESPONSIBILITIES

A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all Work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Provide the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the aluminum walkway cover indicated, described, or implied.

B. As a performance specification, the criteria for the solution of structurally sound aluminum walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the aluminum walkway cover is totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.

C. Design proposal submissions which follow exactly the details indicated on the Drawings for the aluminum walkway cover, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.

D. In the event of a controversy over the design, the decision of the Architect will take precedence.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle sunshade system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

1.8 WARRANTY

A. Written warranty signed by manufacturer, Installer, and Contractor in which manufacturer agrees to repair or replace covered walkway assembly and its components that fail in materials or workmanship within specified warranty period.
   1. Defects shall include, but not be limited to:
      a. Loose or missing parts.
      b. Delamination or deterioration of finish.
      c. Scratched, dented, and damaged surfaces.

   2. Warranty Period: One (1) year from date of Substantial Completion.

B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes does not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: Five (5) years from date of Substantial Completion. **(For Powder Coated Finish).**

PART 2 - PRODUCTS

2.1 MATERIALS

A. Basis of Design Manufacturer: AVAdek, Inc.: Other manufacturers are subject to compliance with requirements:
   1. Canopy-Solutions; (713) 510-3800.
   2. East Texas Canopy.; (903) 839-2091.
   3. Childers Carports & Structures, Inc.
   4. Mapes Industries, Inc. Lincoln, NE; (800) 228-2391.
   5. Peachtree Protective Covers, Inc. (770) 439-2120.
   6. Jones Aluminum Inc. (409) 866-5585
   7. Dittmer Architectural Aluminum, Winter Springs, FL
   8. Perfection Architectural Systems, Inc., an Avadek Company, Orlando, FL
   9. Superior Metal Products Co., Birmingham, AL
   10. Texas Aluminum Industries, Inc., a Metal USA Company; Houston, TX

B. Aluminum Extrusion: ASTM B221 alloy 6063 heat treated to T-6 temper.

C. Aluminum Sheet: ASTM B209, minimum 0.032 inch thickness.

D. Finish: Satin anodize 204-R1 meeting Aluminum Association Specification AA-M-10C-22A-21.

E. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.

F. Fasteners:
   1. Deck Screws: Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8 inch (7 mm) outside dimension, conical washer. Rivets are not permitted.

2. Fascia Rivets: Size 3/16 inch by 1/2 inch (4 mm by 13 mm) grip range aluminum rivets with aluminum mandrel.
3. Bolts, Nuts, and Washers: 18-8 non-magnetic stainless steel.
4. Tek Screws: Not permitted.

G. Beam/Deck connection flashing (Bird cover): .080” thick metal flashing at all beams.

H. Provide concealed drainage from deck into columns.

I. Roof Deck: Shall be of size and depth recommended by the manufacturer to suit application, intended use, requirements of building code authorities having jurisdiction.

J. Expansion Joints: Expansion joints shall have no metal to metal contact.

K. Horizontal U-Beams and vertical tube columns shall be sizes recommended by the manufacturer to suit application, intended use, and requirements of building code authorities having jurisdiction, and shall be attached with concealed fasteners.

2.2 FABRICATION

A. Comply with indicated profiles, dimensioned requirements, and structural requirements. Provide minimum 6 inch by 10 inch (150 mm by 250 mm) structural bents. Provide fascia as indicated.

B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.

C. Mechanical Joints: Consisting of stainless steel bolts with minimum of 2 bolts per fastening. Install bolts and nuts concealed utilizing 1/2 inch thick by 1-1/2 inch (13 mm by 44 mm) aluminum bolt bars welded to structural members.

D. Detail mechanical joints on shop drawings showing each location.

E. Roof Deck: Extruded aluminum shapes, interlocking self flashing sections. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16 feet to offset dead load deflections. Use welded dams at non-draining ends of deck.

F. Expansion joints, design structure for thermal expansion and contraction. Provide expansion joints as required.

G. Provide exposed rivets for fastening bottom of fascia to deck to match fascia finish.

H. Apply shop applied dip coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Pierce column ends to "key" grout to bent for maximum uplift protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for supporting members, blocking, inserts, installation tolerances, and other conditions affecting performance of the work.

B. Confirm locations, dimensions and elevations shown on shop drawings prior to fabrication.

C. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Erection: Set aluminum canopy support tube frames onto steel channels projecting from bidding structure; set to required elevations, align, plumb and level; secure tube frame to structural channels. Comply with manufacturer's instructions.

B. Erection: Set roof support frames (bents) into pockets provided in top of footings; set to required elevations, align, plumb and level; and grout in place with 2,000 psi. portland cement grout. Ensure grout fills voids and keys to columns. Fill downspout units with grout to bottom of discharge level. Install aluminum deflectors after grouting. Match to finish and elevation of adjacent sidewalks.

C. Install roof deck sections, accessories, and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.

3.3 FLASHING

A. Flashings: Flashings required between covered walkway system and adjoining structures are not work of this section. Refer to 07 62 00.

3.4 CLEANING AND PROTECTION

A. Damaged Units: Replace roof deck panels and other components of the work that have been damaged or have deteriorated beyond successful minor repair.

B. Cleaning: Remove protective coverings at time in project construction sequence that provide greatest protection of work. Clean finished surfaces to comply with recommendations of manufacturer.

C. Protection: Protect completed work ensuring walkway cover will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 10 73 13

SECTION 11 65 00 - GYMNASIUM AND PLAY FIELD EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Curtains
2. Batting Cages
3. Control System
4. Wall Padding

B. Related Sections:
1. Division 16 (Division 26) Electrical Section: Installing electrical power to operate gymnasium equipment.

1.2 DESIGN REQUIREMENTS
A. Equipment Loading:
1. Overhead equipment: Locate overhead attachments of equipment in keeping with static equivalent loading and point reactions.

1.3 SUBMITTALS

1. Comply with Section 01330 (01 33 00) – Submittal Procedures.
2. Product Data: Submit manufacturer's product data, including materials, components, fabrication, finish, and installation instructions.
3. Shop Drawings:

a. Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating locations, quantities, dimensions, tolerances, materials, fabrication, connections, hardware, fasteners, finish, electrical wiring diagrams, options, and accessories.
b. Show location and detail of attachment to building structure.

4. Samples: Submit manufacturer's color samples.

5. Design Data: Submit manufacturer's design data, indicating static loads and point reactions

a. Test Reports: Submit manufacturer's certified test reports from testing performed by accredited independent testing laboratory, indicating compliance of materials with requirements as specified.
b. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
c. Manufacturer's Project References: Submit manufacturer's list of recently completed projects, including project name and location, name of architect, and type and quantity of gymnasium and play field equipment installed.
d. Operation and Maintenance Manual: Submit manufacturer's operation and maintenance manual; including operation, maintenance, adjustment, and

cleaning instructions; trouble shooting guide; parts list; and electrical wiring diagrams.

e. Warranty: Submit manufacturer's standard and additional warranties.

1.4 QUALITY ASSURANCE

1. Single Source Responsibility: Provide gymnasium and play field equipment from single manufacturer.
2. Manufacturer's Qualifications: Minimum of 5 consecutive years' experience manufacturing gymnasium and play field equipment similar to that specified.
3. Installer's Qualifications: Trained and approved by manufacturer.
4. Manufacturer shall provide documentation showing welders and processes are AWS certified.
5. Regulatory Requirements: Gymnasium and play field equipment shall conform to latest rules and regulations.

    a. National Federation of State High School Associations (NFHS).

1.5 WARRANTY

1. Provide 1-year warranty against defects in materials and workmanship, unless otherwise specified.

PART 2 PRODUCTS

2.1 MANUFACTURER

1. Porter Athletic, Inc., 601 Mercury Drive, PO Box 1790, Champaign, Illinois 61824-1790. Toll Free (888) 277-7778. Phone (217) 367-8438. Fax (217) 239-2255. Web Site www.porterathletic.com. E-Mail porter@porterathletic.com.
2. Substitutions: Requests for substitutions will be considered in accordance with Section 01630 (01 25 13).

2.2 DIVIDER CURTAINS

1. Arched Form Fold Divider Curtains: Model No. 95060000 gymnasium divider curtains

    A. Curtain shall be formed of one (1) panel of horizontal strips overlap welded 1-1/4" and sewn over at reachable height. Panel is to be of correct size to cover the entire opening except if designated otherwise.
    B. Curtain to have top hem with grommets to attach to support track via carriers and chain, and bottom pocket to accommodate 1 5/8" dia pipe.
    C. Top of curtain shall include traveling mobile pulley at ends to accommodate changing shape of curtain during the fold without requiring additional fabric fullness to be constructed in the curtain. Curtains that do not incorporate traveling pulleys will not be considered equal.

D. There are to be d-rings on 10’-0” centers spaced not greater than 48” apart to allow routing of lifting cables. Manufacturer may decide to alter these dimensions to best suit opening dimensions.
E. Panel shall be formed to accept diagonal cables and curtain shall hang loose and free so that it may fold up to match roof slope/arch/peak
F. Material: Lower Portion – Vinyl 18oz – 6’6” tall; Upper Portion - #36 black netting
G. The centrally located motor drive unit 3 HP-208V-3 phase shall be equipped with magnetic contactors and overload that can stop, start and reverse from any position.
H. Drive shaft shall measure 1” equipped with yo-yo pulleys for each take up line. The pulleys range from 30 times the cable diameter and increase accordingly to accommodate the sloped lift
I. Curtain shall raise at a minimum of 30’ per minute any slower speed will not be considered equal

2. Model No. 90670000 Roll-Fold – Kicking Net 58’ tall x 30’L

A. Material: #36 black 1 ¾” netting with field goal lines markers
B. Support: Top of curtain to be fabricated with a pocket to conceal continuous 1-5/16" O.D. steel tube extending the full length of the curtain to ensure proper support. Tube shall be supported from roller assembly supports on adjustable chains not exceeding 12'-0" centers.
C. Cable: Curtain shall be hoisted by 1/8" diagonal vandal-proof galvanized cable (2,100 lb. breaking strength each cable, spaced between 10'-0" and 12'-0" apart) passing thru metal spur grommet type cable guides on approximate 18" centers. Bottom end of cables to terminate around 1-5/16" O.D. tube in bottom pocket, secured with concealed nicropress, swaged type clamps. Cables shall be routed thru cable guides to fold the curtain in a compact accordion fold arrangement, which lies across bottom support tube as curtain is hoisted. D-ring hoist systems shall not be approved as equal.
D. Support Assemblies: Upper ends of hoist cables shall terminate into individual hoist drums positioned on continuous zinc-plated 2-3/8" O.D. tube line shaft arrangement. Line shaft shall turn in support assemblies equipped with four steel ball bearing wheel rollers. Each support assembly shall be positioned adjacent to a cable hoist drum. Support assemblies shall be secured to structural roof framing supports by means of threaded rods and support chains to provide structural integrity and accommodate all slopes or building camber.
E. Coating: All metal parts not zinc-plated shall be powder coated.

F. Warranty: 1 year limited warranty

2.3 BATTING CAGES

1. Model No. 90920000- Batting/Golf Cage ceiling suspended unit 12’x12’x70’ standard

A. Size: Cage to be 12' high x 12' wide x 70' length (Baseball) and 12’ high x 12’ wide x 55’ length (Softball)

B. Materials: The four sides and top of cage shall be 7/8" square, knotless polypropylene mesh netting (#420 twine). Color of netting to be black. A 1/4" polypropylene rope shall be sewn into the perimeter of each section of netting.

Netting shall be of sufficient size to allow approximately one foot of material to lie on floor to stop balls from being driven under netting.

C. Storage: For compact storage, the supporting frame may be lowered to approximately 3' above the floor in order to place the four sides of netting on top of the frame, requiring a minimum of space in the raised and stored position.

D. Frame: Supporting frame (12' x 70') of cage to be constructed of 1-7/8" O.D. heavy-wall electro-plated tubing with cross spreaders located at 14'-0" centers for hoist cable attachments. Tee fittings shall be provided at each tubing junction. Hoist cables (6) shall be of 1/8" diameter, vandal-proof galvanized cable (2,100 lb. breaking strength each cable). Bottom end of each cable shall terminate in a sling arrangement. Adjustable collars shall be provided for securing cable/sling to supporting frame, allowing for proper support and leveling of frame assembly.

E. Support Assembly: Upper ends of hoist cables shall terminate into individual hoist drums positioned on continuous 2-3/8" O.D. tube line shaft arrangement. Line shaft shall turn in special support assemblies equipped with two 3" diameter polypropylene wheel rollers. Each support assembly shall be positioned adjacent to a cable hoist drum. Support assemblies shall be secured to structural roof framing supports by means of threaded rods, to provide structural integrity and accommodate all slopes or building camber.

F. Coating: Tee fittings and hoist drums shall be finished in a durable gray powder-coated finish.

G. Warranty: 1 year limited warranty

2.4 CONTROL SYSTEM

1. Model No. XELE00407 Powr-Key Control System

A. Operation: System shall be a key-operated control device capable of operating up to 7 unique equipment device types simultaneously in multiple control directions.

B. Operation Safety: Key switch control shall be a momentary switch style requiring constant operator pressure. “Toggle” type switches not featuring momentary style operation shall not be considered equal.

C. Equipment Control: Equipment shall be operated individually or simultaneously by configuring individual switch toggle settings to the “up”, “down”, or “hold” position before initiating an operation via the single key switch controller. Control systems incapable of simultaneous control operation of multiple device types in multiple directions with a single key shall not be considered equal.

D. Individual Device Switch Access: The faceplate of the system shall feature a transparent sliding guard to prevent users from accessing and changing the operational direction of a device switch during a key control operation. Sliding guard shall be raised upward by the operator to set individual switch controls and then lowered to access the single key control cylinder to initiate a control operation.

E. Switch Covers: System shall be furnished with optional switch cover inserts to place over unused device switches in the standard 7-device configuration.

F. Key Cylinder format: The system shall feature a 6-pin small format interchangeable core (SFIC) lock cylinder to allow for incorporation into the facility's master key formatting system.
G. Faceplate Design: The system shall include an oversized aluminum cover plate allowing the option to recess the main electrical enclosure body into a finished wall surface.
H. Faceplate Wire Disconnects: Faceplate wiring terminations shall be a quick connect style for flexible and convenient installation of the system.
I. Enclosure Design: The enclosure shall be a 12" x 12" x 4" deep NEMA 1 rated electrical box with a ANSI 61 gray powder-coated finish.
J. Device Relays: Relays shall be a 25A, 120VAC 2NO electromagnetic switch with a high current rating type. Relays shall feature LED indicators and backup push button activation.
K. Mounting: Enclosure box shall be flush-mounted or surface-mounted by the electrical contractor as specified by electrical contract documents.
L. Power Supply: Power requirements for each and every controllable device shall be determined by the electrical engineer for the project and provided by the electrical contractor.
M. Wiring: System terminal blocks shall have push-in connections, and be capable of accepting up to 10AWG wire. All wiring shall be completed by a licensed electrician in accordance with state and local codes and ordinances.
N. Installation: The electrical contractor shall furnish and install all conduits, wiring, junction boxes, and components not specified herein. Electrical contractor shall be responsible for all electrical rough-in, final connection of switch wiring between the faceplate and the main system terminal blocks, and final faceplate assembly to the main enclosure body.
O. Warranty: 1-year limited warranty.

2.5 WALL PADDING

1. Model No. 5601XX Durasafe Wall Pad No Nailing Margin

A. Wall Pad Dimensions: 2 FT 0 IN Wide by 5 FT 10 IN High
B. Foam: 2 in Thick ,Polyethylene Foam
C. Interior Foam: Bonded to 7/16-inch oriented strand wood board to minimize warping.
D. Panel shall meet the min. ASTM F2440 standard specification for impact rating.
E. Vinyl-Coated Polyester Cover shall meet the requirements for Class A Rating (flame spread 0-25, smoke development 0-450) when tested in accordance with ASTM E-84 (also published as NFPA-255, ANSI 2.5, UBC8-1, and UL 723)
F. Entire Face of Panel: Shall be upholstered in 19-Ounce, fire-retardant, high-tensile, vinyl-coated polyester fabric material with leather-like embossed finish.
G. Cover Material Properties: Mildew resistant, rot resistant, with infection-combating fungicide.
H. Cover shall be folded and securely stapled to backside of the OSB.
I. Color: From manufacturer's standard selection
J. Pads attach with z-clips

PART 3 EXECUTION

3.1 Examination

1. Examine areas and supporting structure to receive gymnasium and play field equipment. Notify Architect in writing of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

1. Install gymnasium and play field equipment in accordance with manufacturer's instructions at locations indicated on the Drawings.
2. Install equipment plumb, level, straight, square, accurately aligned, correctly located, to proper elevation, and secure.
3. Install equipment using manufacturer's supplied hardware and fasteners.
4. Electrical: Install electrical power as specified in Division 16 (Division 26) electrical section.
5. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
6. Remove and replace damaged components that cannot be successfully repaired, as determined by Architect.

3.3 ADJUSTING

1. Adjust basketball backstops, backboards, and goals for plumb and level.
2. Set and adjust electric winch upper and lower limit controls.

3.4 CLEANING

1. Clean gymnasium and play field equipment promptly after installation in accordance with manufacturer's instructions.
2. Remove labels and temporary protective coverings.
3. Do not use harsh cleaning materials or methods that would damage finish.

3.5 DEMONSTRATION

1. Demonstrate operation and maintenance of gymnasium and play field equipment to Owner's personnel.
2. Furnish Owner with keys or passwords to equipment after demonstration.

3.6 PROTECTION

1. Protect installed gymnasium and play field equipment to ensure equipment will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 11 66 23 – ATHLETIC NETTING

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary conditions and division1 specification sections, apply to this section.

1.2 SUMMARY

A. This section includes the following gymnasium equipment:

1. Operable Grand Slam Batting Cage
2. Operable Divider Netting
3. Stationary Roof/Perimeter Netting
4. Touchscreen Operator

1.3 DEFINITIONS

A. FIVB: International Volleyball Federation (Federation Internationale de Volleyball)
B. NAGWS: National Association for Girls and Women in Sport
C. NFHS: National Federation of State High School Associations

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Provide basketball backstops capable of withstanding the effects of earthquake motions determined according to the building code in effect for this project or ASCE 7, “Minimum Design Loads for Buildings and Other Structures”: Section 9, “Earthquake Loads,” whichever is more stringent.

1.5 SUBMITTALS

A. Product data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, features, and finishes. Include details of anchors, hardware, and fastenings. If applicable, include assembly, disassembly, and storage instructions.

1. Gymnasium Equipment Operators: Include operating instructions

B. Shop Drawings: Show location and extent of fully assembled gymnasium equipment. Show location and extent of disassembled equipment and components and transport and storage accessories. Include elevations, sections, and details not shown in product data. Show method of field assembly, connections, installation details, mountings, floor inserts, attachments to other work, operational clearances, and relationship to adjoining work.

1. Blocking and reinforcement: Show locations of blocking and reinforcement required for support of gymnasium equipment.

C. Coordination Drawings: Court layout plans and elevations drawn to scale and coordinating floor-insert penetrations and game lines and markers applied to finish floor.
D. Samples for initial selection: For each type of gymnasium equipment indicated where feasible.
E. Samples for verification: For the following products

1. Pad fabric: complete line of manufacturers colors with material specifications included.

F. Product certificates: For each type of gymnasium equipment, signed by product manufacturer.
G. Manufacturers certificates: Signed by manufacturers certifying that they comply with requirements. Include evidence of manufacturing experience.
H. Qualification data: For professional engineer
I. Maintenance Data: For gymnasium equipment and gymnasium equipment operator to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer
B. Source limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.
C. Standards: Provide gymnasium equipment complying with or exceeding the requirements of the State High School Association

1.7 PROJECT CONDITIONS

A. Environmental limitations: Don not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for it's intended use.
B. Field measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment. Verify dimensions by field measurements.

1.8 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and markers on finished floor.
B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aalco or pre-approved equal

2.2 MATERIALS, GENERAL

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; mill finish or decorative, baked-enamel, powder- coat finish.

1. Extruded Bars, Profiles, and Tubes: ASTM B 221

2. Cast Aluminum: ASTM B 179

B. Steel: Comply with the following

1. Steel plates, shapes, and bars: ASTM A 36/A 36M, hot dipped galvanized
2. Steel pipe: Standard-weight steel pipe complying with ASTM A 53.
3. Cold formed Steel tubing: ASTM A 500, Grade A, unless another grade is required by structural loads.
4. Steel mechanical tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513 or steel tubing fabricated from steel complying with ASTM A 569/A 569 M and complying with the dimensional tolerances in ASTM A 500.
5. Malleable- iron castings: ASTM A 47, Grade required by structural loads.
6. Support cable: ¼ inch- (6mm) diameter, 7x19 galvanized steel aircraft cable with a manufacturers written recommendation for size, number, and method of installation.
7. Support chain: Proof coil chain, complying with ASTM A 413/A 413M, grade 30, size and diameter as required by structural loads; plated or painted. Provide fittings complying with chain manufacturers written recommendations for size, number, and method of installation.

C. Particleboard: ANSI A208.1.

D. Wood-based, Structural-use panels: Comply with DOC PS 2; for plywood, comply with DOC PS 1.

E. Equipment mounting pads: Wood, transparent or neutral color painted finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written recommendations

F. Anchors, fasteners, fittings, and hardware: Manufacturer's standard corrosion resistant or non-corrodible units. Provide as required for gymnasium equipment assembly, mounting, and secure attachment.

G. Non-shrink, non-metallic grout: Premixed, factory- packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

2.3 OPERABLE GRAND SLAM BATTING CAGE

A. Specifications herewith are based upon products produced by Aalco Manufacturing Company, St. Louis, MO 63125.

1. Provide Aalco Mfg. Co. model #GS-2 (Grand Slam-Double Batting Lift Cage) or approved equal

a. Provide a double batting cage, 70' long x 12' high x 24' wide.

b. The upper-super structure shall consist of 5/16" braided polyester rope suspended by means of welded and bolted adjustable drops braced in the appropriate planes. The roof and upper edge of the perimeter will be secured to these adjustable drops. Cage shall be raised & lowered by 1/8"-7x19 plastic coated aircraft cables secured to the custom fabricated drums that are attached to the 1.9" OD drive system attached to the system's motor. The drive shaft shall be supported from the super structure by means of pillow block bearings

The lower portion of the cage will consist of a vinyl batten pocket that, when raised, will follow the slope of the building. The operator shall allow the continuous steel batten to be lowered to floor level and raised to the limits that are set during installation.

c. Perimeter cage net shall be constructed of 1-3/4" square mesh, #72 knot-less nylon netting treated for ultraviolet resistance. While the roof net shall be constructed of 1-3/4" square mesh, #42 knot-less nylon netting. All wall & roof junctures and all free edges shall be reinforced with a machine-woven rope. Machine sewn-in zipper doors will allow entering/exiting of cage at the owner's desired locations. Height of cage walls shall be of maximum vertical distance allowed by building structure. There shall be an 8" vinyl pocket attached securely to bottom edge of netting, which shall provide housing for the bottom continuous batten. In lowered position the batten shall rest on finished floor to deter balls from being driven under netting.

d. Cage shall contain an operable divider net to divide the cage into equal parts for appropriately sized batting tunnels. Divider shall consist of the same #72 knot-less nylon netting as the perimeter of the cage. The upper-super structure shall consist of 5/16" braided polyester rope suspended by means of welded and bolted adjustable drops braced in the appropriate planes. The lower portion of the cage will consist of a vinyl batten pocket that, when raised, will follow the slope of the cage it resides in. The operator shall allow the continuous steel batten to be lowered to floor level and raised to the limits that are set during installation.

e. Cage storage operation shall be provided by the model #74RC electric operation. An additional motor will be supplied to operate the internal divider net. Operator shall include the following features: 120VAC, capacitor-start, overload-protected 1HP; 2) worm-gear speed reduction for unassisted support of load at all times, including the event of a power failure; 3) lubed-for-life bearings and gearing; 4) hoist-mounted, pre-wired rotary travel control mechanism, easily set to automatically limit both up & down travel; 5) reversing magnetic contactor enabling 3-wire remote control of hoist; and 6) up-off-down, momentary-contact, flush mounting control switch to be mounted in a remote location, touch screen to prevent unauthorized operation. Electrical conduit, wiring, etc. from the operator to power and to the remote wall switch shall be by others (electrical contractor).

2.4 OPERABLE DIVIDER NETTING

A. Specifications herewith are based upon products produced by Aalco Manufacturing Company, St. Louis, MO 63125.

1. Provide Aalco Mfg. Co. model #VSCC (ceiling suspended) contouring fold-up gymnasium divider net.

a. Curtain shall screen openings approximately 300' along field, 210' across the field and 100' with tape marked end zone at end zone wide and raise to storage position that follows the contour of the roof framing. The curtain shall be one piece. Storage position shall closely approximate the contour of the

roof framing. The curtain shall be electronically welded to size from horizontally running, mill-width fabric panels using 1.5" lap welds.

b. The upper area of curtain shall be constructed of 1-3/4" square mesh, #42 knot-less nylon netting treated for ultraviolet resistance.

c. The top edge of each curtain half shall house a continuous, 1.9" dia. rigid-coupled, tubular steel batten to provide uniform line and support. A like batten shall provide ballast & even line in a sleeve in the bottom edge. Raising of the curtain shall be by hoist lines of 1/8"-7x19 aircraft cable, spaced at uniform intervals not exceeding 10' across the width of the curtain. Each line shall secure to the bottom edge chain/batten and lace up thru rings sewn to the curtain at 18" intervals so as to gather the curtain as the lines are taken up. At the ceiling the hoist lines shall train thru multiple pulley blocks to a winch drum partitioned to provide one drum for each line. The drum diameter for each line shall be sized as needed to raise the curtain to the sloped storage position.

d. The electric winch shall include the following features: 20 ft/min. curtain operation; a 1HP, **instant-reversing,** 120 VAC cap-start, overload-protected motor; load support at all times thru self-locking worm-gearing; lubed-for-life bearings; screen-operated; and a travel control mechanism to automatically limit up & down travel.

e. up-off-down, momentary-contact, flush mounting control switch to be mounted in a remote location, touch screen to prevent unauthorized operation. Electrical conduit, wiring, etc. from the operator to power and to the remote wall switch shall be by others (electrical contractor).

2.5 STATIONARY ROOF/PERIMETER NETTING

A. Specifications herewith are based upon products produced by Aalco Manufacturing Company, St. Louis, MO 63125.

1. Provide Aalco Mfg. Co. Stationary Roof Netting Aalco Model #SRNS-42

a) Provide all suspension hardware brackets, cables etc. to cover entire roof of structure wall to wall with #42 -1 ¾" x 1 ¾" HDPE netting. Netting to be installed in sections per manufacturing recommendations to eliminate sagging as much as possible. Custom hardware shall be provided to work around any HVAC, lighting, sprinklers that may come into conflict. All netting edges to be finished with rope edges secured to cables w/ galvanized hog rings or custom snap bits.

2. Provide Aalco Mfg. Co. Stationary Wall Netting Aalco Model #SWNS-42 or approved equal

a) Provide all suspension hardware brackets, cables etc. to cover walls down to wall padding with #42 -1 ¾" x 1 ¾" HDPE netting. Netting to be installed in sections per manufacturing recommendations to eliminate sagging as much as possible. Custom hardware shall be provided to work around any decks or towers, HVAC, sprinklers, etc. that may come into conflict. All netting edges to be finished with rope edges secured to cables w/ galvanized hog rings or custom snap bits.

2.6 TOUCH SCREEN OPERATOR

A. Specifications herewith are based upon products produced by Aalco Manufacturing Company, St. Louis, MO 63125

1. Provide Aalco Mfg. Co. Model #TM-10 (Wall Mounted Touch Screen)

a. Motorized batting cage and divider nets provided by Aalco shall be operated from a remote location using AALCO's TM-10 Touch Mate system for simultaneous multi-tasking Gymnasium control center. The TM-10 Touch Mate Touch Screen shall be furnished as a unit in a flush-mounted electrical enclosure to be field installed in the desired location with the screen near eye level by others. Touch screens shall consist of color TFT LCD touch/display screens. Screen size shall be 10". Locate Touch Screen units as determined by the architect, coordinating with all other relevant trades.

b. The Touch Screen control system shall include at least one relay/contactor panel per room of equipment to be controlled. These relay panels shall be mounted at any given wall in a secure location, or nearby in an electrical equipment room. Each motorized device shall be powered through this relay panel from a **dedicated** 120-volt, 20-amp circuit. All relays shall have a 120-volt, 30-amp rating. Relay panels that do not allow for a dedicated 20-amp circuit for each motor will not be considered equal.

c. Touch screen control shall be capable of operating all motorized gymnasium equipment. All equipment may be activated, in any combination, simply by touching the icon on the screen. Icons will blink to show activation.

d. The graphic display Touch Screen provides an easy plan view for identifying and selecting the specific backstops, height adjustors, or curtains to be raised or lowered. Backstops and height adjustors may be operated individually, in pairs, or in any group selected. Once selected, constant pressure on the Raise or Lower button will move equipment until the button is released.

e. A five-digit programmable security code shall be used to prevent unauthorized use of the control system. The system shall allow for authorized reprogramming of the security code at any time. The Touch screen will reset after a 30-second time period into a secure mode if no button is pressed. Multiple Touch Screens may be utilized when operation from various locations is desired. Systems without multiple Touch Screen capability will not be considered equal. Field wiring for the TM-1 Touch Mate Touch Screen system shall be coordinated with the relevant contractors.

f. Field wiring to the Touch Screen control units will consist of 24-volt DC power circuit and 1 3 wire shielded communication cable from each corresponding relay panel.

g. Field wiring for the Touch screen control relay panels will consist of one 120-volt, 20-amp power circuit per motorized unit. Control power to each motorized unit will be 120 volt, 20-amp, 3-wire + ground. Terminals will be provided for all field wiring. Specific termination points will be identified in the panel according to the system engineered drawings.

h. Wiring of all electrical components shall be in accordance with local codes, and in accordance with manufacturer's instructions. All wiring, conduit, junction boxes, and other components not specified shall be furnished and installed by the electrical contractor.

PART 3 -EXCECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, [accurate locations of connections to building electrical system,] and other conditions affecting performance.

1. Verify critical dimensions.

2. Examine supporting structure, subgrades, subfloors and footings below finished floor.

3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.

4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly, where required.

B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.

C. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.

1. Floor Insert Location: Coordinate location with application of game lines and markers and core drill floor for inserts after game lines have been applied.

2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and type of floor plate.

3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

D. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete slabs and footings. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Follow manufacturer installation drawings for proper sleeve installment.

E. Wall, Corner and Column Safety Pads: Mount with bottom edge at 4 inches (102 mm) above finished floor (or) dimensions indicated on drawings.

F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.

G. Electrical Connections: Shall be completed by a certified electrician.

H. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration has been approved by Architect and/or Owner.

3.3 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION

1.1

1.2

1.3

1.4 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections

1.5 SUMMARY

A. Section Includes: Requirements including but not limited to:
1. Wall padding for calming rooms.
2. Accessories necessary for a complete installation.

1.6 SUBMITTALS

A. Product Data: Technical data for each type of product, including assembly, disassembly, and storage instructions for removable equipment and to indicate the performance, fabrication procedures, product variations, and accessories

B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.

1.7 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.

B. Coordinate layout and installation of overhead supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

1.8 WARRANTY

A. Written warranty in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Buck Terrell; (713) 673-2577. Other manufacturers are subject to compliance with requirements as specified in Division 01 under Substitutions.

2.2 MATERIALS

A. Wall Padding: ASTM E 84, Class A; NFPA-701, Large Scale Test.

1. Composition: Heavy Duty Vinyl Cover, #110 I.L.D. low smoke polychloroprene latex compound with U.V. pigments for weather resistance.
2. Backing: 7/16-inch oriented strand board (OSB) for permanent mounting.
3. Size: 2-inch.
4. Density: 8-9.5 lbs.
5. Finish: Leather emboss finish.
6. Weight: Minimum weight of 14 oz. per square yard.
7. Fabric: Coated.
8. Treatment: Anti-mildew.
9. Colors: Architect to select from manufacturer’s full range.
10. Weave count: 9 X 9.
11. Core fabric denier: 1300.
12. Grab Tensile: 450 X 505 lbs./in.
13. Tongue Tear: 75 X 75 lbs/in.
14. Adhesion: 25 lbs/ 2 in.

B. Accessories:
1. Fasteners: Wood screws per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions.

3.3 CLEANING

A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop applied finishes according to manufacturer's written instructions.

END OF SECTION 11 66 23.53

SECTION 11 66 23.53 – WALL PADDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 60 16 – Interior Design Selections

1.2 SUMMARY

A. Section Includes: Requirements including but not limited to:
   1. Wall padding for calming rooms.
   2. Accessories necessary for a complete installation.

1.3 SUBMITTALS

A. Product Data: Technical data for each type of product, including assembly, disassembly, and storage instructions for removable equipment and to indicate the performance, fabrication procedures, product variations, and accessories

B. Shop Drawings: Submit plans, elevations, sections, details, and attachments to other work.

1.4 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.

B. Coordinate layout and installation of overhead supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire suppression system components, and partition assemblies.

1.5 WARRANTY

A. Written warranty in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Buck Terrell; (713) 673-2577. Other manufacturers are subject to compliance with requirements as specified in Division 01 under Substitutions.

2.2 MATERIALS

A. Wall Padding: ASTM E 84, Class A; NFPA-701, Large Scale Test.
   1. Composition: Heavy Duty Vinyl Cover, #110 I.L.D. low smoke polychloroprene latex compound with U.V. pigments for weather resistance.

2. Backing: 7/16-inch oriented strand board (OSB) for permanent mounting.
3. Size: 2-inch.
4. Density: 8-9.5 lbs.
5. Finish: Leather emboss finish.
6. Weight: Minimum weight of 14 oz. per square yard.
7. Fabric: Coated.
8. Treatment: Anti-mildew.
9. Colors: Architect to select from manufacturer's full range.
10. Weave count: 9 X 9.
11. Core fabric denier: 1300.
12. Grab Tensile: 450 X 505 lbs./in.
13. Tongue Tear: 75 X 75 lbs/in.
14. Adhesion: 25 lbs/ 2 in.

B. Accessories:
1. Fasteners: Wood screws per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance.

B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions.

3.3 CLEANING

A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop applied finishes according to manufacturer's written instructions.

END OF SECTION 11 66 23.53

SECTION 12 11 00 - DIGITALLY-PRINTED VINYL WALL GRAPHICS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Very large scale vinyl wall graphics (murals) digitally printed on self-adhesive vinyl graphics film from electronic graphic image files furnished by the Architect, adhered to gypsum board surfaces with a Level 5 skim coated, smooth painted finish or painted CMU.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Installation drawings: Indicate configuration and dimensions of substrate(s) including (if applicable) penetrating and protruding elements; vinyl mural panels; seam locations; details of installation; and related and adjacent work. Note field-measured dimensions.

B. Product Data:
   1. Manufacturers' specifications for vinyl film medium, inks and laminating film, and other data sufficient to demonstrate compliance with specified requirements
   2. Manufacturer’s written preparation, installation, and cleaning and maintenance instructions and recommendations

C. Samples:
   1. Color Approval Proof:
      a. Full color laminated print produced with the same equipment that will be used for the actual vinyl wall graphics panels, using the specified resolution, ink sets, vinyl film printing medium and clear protective laminating film, in a size proportional to the finished mural, with the lesser dimension approximately equal to the width of the vinyl film medium.
      b. Make adjustments, reprint and resubmit as necessary to obtain Architect's approval.

D. Certificates: Submit written certification, on graphics provider firm's letterhead, that products and installation comply with specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

A. Maintain room and substrate temperature and humidity within the ranges recommended by the graphic film manufacturer at least 48 hours prior to, during, and after installation, until Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, handle and store products as recommended by the manufacturer(s), in graphics provider's labeled protective packaging. Protect from damage and deterioration.

1.6 WARRANTY

A. Graphics provider shall provide a 10-year material and labor warranty against fading, edge lifting, peeling, discoloration, delamination of the overlaminate from the vinyl graphics film, and delamination of the vinyl film from the painted Level 5 skim-coated smooth-painted gypsum board substrate or painted cmu substrate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS, MANUFACTURERS AND GRAPHICS PROVIDERS

A. Specifications are based on products, manufacturers and graphics providers named herein or listed as the Basis of Design. Products of manufacturers listed which meet or exceed specifications are approved for use on the Project. Other manufacturers and graphics providers must have a minimum of five years experience supplying (and for graphics providers, installing) products meeting or exceeding the specifications, and comply with requirements of Section 01 25 13 Product Substitution Procedures to be considered.

2.2 GRAPHICS PROVIDER

A. Basis of Design: Riot Creative Imaging division of ARC (Dana LaPointe), 6300 Gulfton, Houston, TX 77081; 713-830-3933; dana.lapointe@riotcolor.com; www.riotcolor.com

B. Single-source Responsibility: Graphics Provider shall be solely responsible for processing, production and installation, whether installation is performed by its own personnel or by its approved installation contractor.

2.3 EQUIPMENT

A. Basis of Design Printer: HP 3000 grand format inkjet printer with HP 881 Latex Printheads; 54 inch wide media capacity; 600 dpi minimum resolution, or equivalent equipment acceptable to the Architect and compatible with the specified (or approved substitution) inks and media.

B. Laminator: Compatible with the specified (or approved substitution) vinyl film media, inks and overlaminate.

2.4 MATERIALS

A. Basis of Design for VWC-Drywall Application:
   1. Protective Laminated Film: ClearShield Wall Armor film. Category V Type II.
      a. Colorfastness: Greater than or equal to 200h.
      b. Washability: Greater than or equal to 100 cycles.
      c. Scrubbability: Greater than or equal to 300 cycles.
      d. Abrasion Resistance: Greater than or equal to 300 cycles.
      e. Cracking, Drying: Good.
      f. Stain Resistance to Reagents: 4.
      g. Flame Spread: Less than or equal to 25.

   2. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
      a. Curing: Heat and infrared cured
      b. VOCs: Less than 294 g/L
      c. Hazardous Air Pollutants (HAPs): None.
      d. Hazard Warning Labels: None (cautionary only; no "R" phrases).

e. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C

3. Vinyl Wall Covering: Dreamscape Suede.
   a. Description: Commercial grade vinyl printable vinyl wallcovering media for modern wide format inkjet printers.
   b. Construction: Embossed vinyl face with laminated fabric backing.
   c. Backing: Poly-cotton woven or polyester/pulp non-woven.
   d. Type Properties: Passes all criterion for WA 101, Type II.
   e. Thickness: 0.017 in.

4. Accessory products, tools, and equipment: Recommended by, or acceptable to, the manufacturers of the materials with which they are used.

B. Basis of Design for CMU Application:
1. Vinyl Graphics Film: 3M™ "IJ180Cv3-10 Controltac™ Graphic Film" cast vinyl film suitable for inkjet printing. Calendared films are not acceptable.
   a. Film Thickness: 0.05 mm (2 mil, 0.002 inch)
   b. Surface: Smooth, white, opaque and glossy.
   c. Applied shrinkage: < 0.1 mm per FTM 14.
   d. Adhesive: Factory-applied 3M "Comply™ v3" solvent acrylic pressure-sensitive repositionable adhesive with air release channels, protected by double-sided polyethylene coated paper, for dry application only, for permanent, non-removable installation.
      1) Adhesion: Approximately 18 N/25 mm per FTM 1 (180 degree peel, glass, 24h, 23 degrees C, 50 percent RH)

2. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
   a. Curing: Heat and infrared cured
   b. VOCs: Less than 294 g/L
   c. Hazardous Air Pollutants (HAPs): None.
   d. Hazard Warning Labels: None (cautionary only; no "R" phrases).
   e. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C

3. Protective Laminating Film: 3M™ "Envision™ Luster Wrap Overlaminate 8548L" cast film. Calendared films are not acceptable.
   a. Luster high performance non-PVC film
   b. Exceptional conformability and lifting resistance
   c. Less prone to scratching
   d. Superior UV and acid dew protection
   e. Longer term vertical durability
   f. Horizontal warranty

2.4 PROCESSING AND PRODUCTION

A. Lay out each mural image in full-height vertical panels without horizontal seams. Allow overlap at vertical seams for accurate alignment and trimming. Unless otherwise specifically authorized by the Architect, lay out so panels are equal in width and arranged symmetrically. In no case shall a panel be less than one-half the vinyl media width.

B. For uniform appearance, produce all panels using vinyl film media, inks, and laminating film that are each sourced from a single manufacturing lot or production run.

C. Each panel shall be free from skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint as many panels as necessary for flawless appearance and consistent color match between all panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. With the installer, examine the conditions affecting work of this section, including but not necessarily limited to substrate surface smoothness, cleanliness, and uniformity; adjacent materials; and temperature and humidity.
   1. Confirm that substrate surfaces are properly finished, smooth, and clean, and are free of contaminants, texture, roughness, voids, protrusions and other surface irregularities that could impair adhesion or telegraph through the applied film.
   2. Report unsatisfactory conditions to the Architect in writing.
   3. Confirm adhesion is satisfactory if necessary through adhesion tests on site prior to production of final prints.
   4. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of installation shall be deemed to be acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Acclimatize printed vinyl film and other materials to the environment where they will be installed for at least 24 hours prior to commencement of installation, or for a longer period if recommended by the manufacturer.

B. Prior to installation, re-inspect mural panels closely for skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint and replace as many panels as necessary for flawless appearance and consistent color match between all panels.

3.3 INSTALLATION

A. Digitally-Printed Vinyl Murals:
   1. Installation shall be performed only by trained, experienced personnel approved by the graphics provider.
   2. Install in accordance with manufacturer’s instructions and reviewed submittals.
   3. Install in location(s) shown on drawings and according to any additional instructions laid out in installation guidelines to be provided by the Architect
   4. Seams: Hairline, with overlapped, razor-cut butt joints. Visually align adjacent panels for accurate registration with no visible gaps, offsets or misalignments.
   5. Install without bubbles, wrinkles, gaps, fish mouths and other surface and seam irregularities for a smooth, uniform appearance.

3.4 CLEANING AND PROTECTION

A. Protect installed work from deterioration and other damage as recommended by the manufacturer until date of Substantial Completion.

B. If necessary and possible, clean or repair murals to restore to like-new condition following manufacturer's written instructions and recommendations.

C. Replace materials found to be defective or damaged, if it is not possible to clean or restore them to like-new condition.

D. Clean and repair damaged adjacent surfaces and other work damaged by the work of this section. If damage cannot be cleaned or repaired to the equivalent of new condition (or for existing materials, their condition prior to damage from construction), replace damaged materials with new undamaged materials.

END OF SECTION 12 11 00

SECTION 12 24 00 - WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Section 01 60 16 – Interior Design Selections

1.2 SECTION INCLUDES

A. Window shades and accessories for room darkening.

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
   2. Manufacturer's installation instructions.

B. Shop Drawings:
   1. Indicate field verified dimensions of openings scheduled to receive shades.
   2. Indicate fabric selection, operator, hardware style, and finish.
   3. Show location and installation procedures.
   4. Include details, attachments and clearances for Architect's approval.

C. Samples or color charts showing manufacturer's full range of material colors for Architect’s selection.

1.4 PRODUCT DELIVERY

A. Deliver to job site in manufacturer’s original cartons.

B. Label shades with room and opening location in accordance with Room Finish Schedule.

C. Carefully handle and store shades to prevent damage to materials, finishes, and operating mechanisms.

1.5 PROJECT CONDITIONS

A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.6 PRODUCT DELIVERY

A. Hardware and Shade Fabric: Draper's standard twenty-five (25) years limited warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on MechoSystems as manufactured by Mechoshades; (Other manufacturers are not precluded from making a proposal on this Project, but to do so, they must

have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.

2.2 METHOD OF OPERATION

A. Bead Chain Clutch: Bead chain and clutch operated, vertical roll-up, fabric, opaque window shade system, complete with headbox, side and sill channels for total opacity.

2.3 HARDWARE

A. Rollers (except shades with spring rollers): Sizes 1-1/2 inch diameter with 0.065 inch wall or two (2) inch diameter with 0.080 inch wall of 6063-T5 aluminum extruded tube. Roller assembly easily removable.

B. Roller Idler Assembly: Type 6/6 injected molded nylon and a zinc-plated cold rolled steel pin. Sliding pin for easy installation and removal of the roller.

C. Endcaps: 1028 steel stamping, 3-1/4 inch x 3-3/4 inch, complete with roller adapter bracket. Installs to face, ceiling, or jamb as shown or required. Accepts snap-lock roller box cover and fabric guide. Clear anodized, black, white, ivory, or dark bronze baked enamel finish as selected by Architect.

D. Head Box, Channels & Slat Bar: 6063-T5 aluminum custom extruded shapes, 0.060 inch wall. Clear anodized finish or black, white, ivory, or dark bronze baked enamel finish as selected by Architect. All contain grooves to accept light seal elements.
   1. Head Box: (Configuration shown or required)
      a. For Surface or Jamb Installation (standard): Shall consist of an L-shaped back/top and an L-shaped front/bottom.
      b. For Pocket Installation: Shall include a U-shaped back/top/front with removable bottom. Some exposed fasteners required.
   2. Side Channels: Shall be of one-piece construction. Channel consists of two (2) chambers. One (1) accepts the fabric and contains groove for fabric retainer. The second accepts the fabric guide and channel locator. Face-mounted units require plastic cover buttons.
   3. Sill Channel: Accepts the slat bar, prevents light leakage. Bottom of channel provides for use of flat head screws.
   4. Slat Bar: Shall be furnished with sill channel and is attached to the bottom of shade fabric. Includes a chamber for additional weight if needed for smooth operation. Does not retract into operator enclosure (headbox).

E. Channel Locator: Type 6/6 injected molded nylon. Aligns enclosure and channels.

F. Fabric Guides: Plated steel. Forms a transition for the fabric as it rolls into the channels, reducing friction.

G. Patented Fabric Retention: Horizontal steel stays are installed at regular intervals and covered. At each end of stays, a grommet is installed through the stay and shade fabric. The grommets are then held within the side channels by fabric retainers. This system enables the shade to withstand reasonable air pressure differentials. Note-Extreme air currents or physical interference may cause product failure.

H. Opacity Plates: 1018 steel with a rubber “O” ring. Installed on the endcaps of the roller box to eliminate light leakage.

2.4 OPAQUE WINDOW SHADE SYSTEM

A. Operation Type: Manual, vertical roll-up, fabric, opaque window shade system, complete with headbox, side and sill channels for total opacity; MechoSystems as manufactured by MechoShades.

B. Roller Tube: Fabricated from extruded aluminum, galvanized steel, or enameled steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade type and size. Fabric connected to the roller tube with LSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.

C. Headbox: Consists of extruded aluminum sections with endcaps and opacity plates.
1. Size: 5 inches high by 5 inches wide by length required for shade being provided.
2. U-shaped front, back, and top and removable bottom.

D. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb. Provide size compatible with roller size.

E. Side Channels: Double chamber fabricated from 0.06 inch (1.5 mm) thick extruded aluminum sections. One chamber accepts fabric and contains groove for fabric retainer. Other chamber accepts fabric guide and channel locator.

F. Sill channel: L bracket to prevent light leakage.

G. Slat bar: Extruded aluminum bar attached to bottom of shade. Bar does not retract into headbox.

H. Channel locator: Injected molded nylon insert to align side and sill channels with headbox.

I. Fabric guide: Plated steel transition for fabric rolling into side channel.

J. Fabric retainer: System designed to prevent disengagement of fabric from side channels due to normal variations of air pressure caused by doors opening, HVAC systems, and temperature differences between room and window well. System consists of horizontal steel stays installed in shade, covered with fabric, and spaced at regular intervals. Grommets installed through stays are held within groove of side channel chamber.

K. Exposed aluminum finish:
1. Finish: Black.

2.4 FABRICS

A. Light-Filtering Fabrics
1. Mechoshade Solar Shade: Soho, 1600, 3% Open,
2. VOC Emissions: GREENGUARD Children & Schools -certified as a low emitting fabric. Manufacturer to supply GREENGUARD Children & Schools certificate. 500 denier fiberglass, vinyl coated and woven into a 2 x 2 of fabric noted above. Fire rating: NFPA 701. Bacteria and Fungal Resistance: ASTM G 21 and ASTM G 22. Series SW2400, 3 percent open, .019 inches thick.
3. Color and pattern: Architect to select from manufacturer’s full range of colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of

unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.

B. Coordinate installation of recessed shade pockets with construction of suspended acoustical panel ceilings specified in Division 9.

C. Coordinate installation of recessed shade pockets with construction of suspended gypsum board ceilings specified in Division 9.

3.3 INSTALLATION

A. Install shades at locations scheduled, noted on the drawings, or as directed by the Architect in accordance with manufacturer's installation procedures, except as otherwise specified herein.

B. Install intermediate support and extension brackets as needed to prevent deflection in headrail.

C. Install shades with adequate clearance to permit smooth operation of shades and any sash operators. Hold shades 1/4 inch clear from each side of window opening on inside mount, unless other clearance is indicated.

D. Provide 20 gauge, galvanized steel strap for anchoring.

3.4 CLEANING AND DEMONSTRATION

A. Clean shades in accordance with manufacturer's instructions.

B. Demonstrate shades to be in smooth uniform working order.

END OF SECTION 12 24 00

SECTION 13 34 19 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manufacturer-engineered, shop-fabricated structural steel building frame.
B. Insulated Metal wall and roof panels including gutters and downspouts.
C. Exterior doors, windows, skylights, overhead doors, and louvers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.3 SUBMITTALS

A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
B. Product Data: Provide data on profiles, component dimensions, fasteners.
C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
D. Color Chart: Submit printed color chart with full range of available standard color
E. Samples: Submit two samples of precoated metal panels for each color selected, 2 by 2 inch in size illustrating color and texture of finish.
F. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement, and other erection instructions.
G. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
H. Designer's Qualification Statement.
I. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
    1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.
J. Erector's Qualification Statement.
K. Welders’ Qualification Statement: Welders’ certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
L. Project Record Documents: Record actual locations of concealed components and utilities.

1.4 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
    1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
    2. Comply with applicable code for submission of design calculations and reviewed shop and erection drawings as required for acquiring permits.

3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

B. Perform work in accordance with AISC 360 or MBMA (MBSM).
   1. Maintain one copy on site.

C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
   1. Not less than three years of documented experience.
   2. Accredited by IAS in accordance with IAS AC472.

D. Erector Qualifications: Company specializing in performing the work of this section with minimum 3 years experience or listed by manufacturer.

E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.5 WARRANTY

A. See Section 01 78 39 - Project Record Document, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty for entire building excluding masonry veneer.
   1. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Buildings Systems:
   1. D&M Metal Works: www.dandmmetalworks.com.
   2. Mueller Metal Buildings: www.dandmmetalworks.com.
   3. Butler Manufacturing Company: www.butlermfg.com.
   4. Ceco Building Systems: www.cecobuildings.com.
   5. Chief Buildings: www.chiefbuildings.com.
   6. Kirby Building Systems: www.kirbybuildingsystems.com.
   7. Metallic Building Systems: www.metallic.com.
   8. Nucor Building Systems: www.nucorbuildingsystems.com.
   9. VP Buildings: www.vp.com.

2.2 ASSEMBLIES

A. Single span rigid frame.

B. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, braced end frames, and end wall columns, and wind bracing.

C. Secondary Framing: Purlins, Girts, Flange bracing, and Clips, and other items required for a compete building.

D. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly, and accessory components.

E. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly, insulation, and liner panels, and accessory components.

F. Roof Slope: 4 inches in 12 inches.

2.3 PERFORMANCE REQUIREMENTS

A. Installed Thermal Resistance of Roof System: R-value as shown on drawings.

B. Design all structural members to withstand dead loads, live loads, snow loads, and wind loads due to pressure and suction of wind calculated in accordance with the applicable codes and with all applicable load combinations consistent with either ASD or LRFD design methodologies. Minimum live load for roof shall be 20 psf. Minimum ground snow load shall be 5psf (PEMB Designer to apply all applicable factors to load based on building geometry, thermal factors, importance, etc., and Importance Factor III). Min wind loads shall be determined by PEMB Designer in accordance with all applicable code required factors based on building geometry, building elevations, roof pitch, etc. utilizing a minimum wind speed of 112mph 3-second gust with an Importance Factor of III).
C. Design structural members to withstand Class 30 wind uplift in accordance with UL 580.
D. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of 1/90 of span for walls and 1/180 for roofs.
E. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
F. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 200 degrees F.
G. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.4 MATERIALS - FRAMING

A. Structural Steel Members: ASTM A36/A36M.
B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
D. Anchor Bolts: ASTM A307, Grade A, with no preference for protective coatings.
E. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with no preference for protective coating.
F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.
G. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.
H. Primer: SSPC-Paint 20 zinc rich.
I. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
   3. Height Change, Plastic State: When tested in accordance with ASTM C827/C827M:
      a. Maximum: Plus 4 percent.
      b. Minimum: Plus 1 percent.

2.5 MATERIALS - WALLS AND ROOF

A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
B. Steel Sheet: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.
C. Insulation: Semi-rigid glass fiber type, unfaced, ASTM E84 Class A, flame spread index of 25 or less where exposed, friction fit, _____inches thick.
D. Insulation: ASTM C665 Type I; _____inches thick.
   1. Facing: Sheet vinyl, _____inch thick, white.

refer to 07

E. Metal Building Type, Factory Applied, Vapor-Barrier Insulation Facings: Water vapor permeance no greater than 0.10 perm when tested in accordance with ASTM E96/E96M; flame

spread index of 25 or less, and smoke developed index of 40 or less when tested in accordance with ASTM E84.

1. Manufacturers:
   a. Lamtec Corporation; WMP-RETRO: www.lamtec.com/#sle.
   b. Substitutions: See Section 01 60 00 - Product Requirements.

F. Joint Seal Gaskets: Manufacturer's standard type.
G. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
H. Bituminous Paint: Asphaltic type.
I. Sealant: Manufacturer's standard type.
J. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.
K. Metal Mesh: Galvanized steel wire, woven.
L. Roof Curbs: Insulated metal same as roofing, _____inch thick, designed for imposed equipment loads, anchor fasteners to equipment, counterflashed to metal roof system.
M. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.6 COMPONENTS

A. Doors and Frames: Manufacturer's standard.
B. Ventilators: Low profile ridge vent.

2.7 FABRICATION - FRAMING

A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
C. Provide framing for ventilator and other openings.
D. Provide wall opening framing for doors, windows, and other accessory components.

2.8 FABRICATION - WALL AND ROOF PANELS

refer to spec

A. Siding: Minimum _____inch metal thickness, _____profile indicated, _____inch deep, lapped edges fitted with continuous gaskets.
B. Roofing: Minimum _____inch metal thickness, _____profile, lapped edges fitted with continuous gaskets.
C. Liner: Minimum _____inch metal thickness, flat profile indicated, lapped V edges fitted with continuous gaskets.
D. Soffit Panels: Minimum _____inch metal thickness, flat profile indicated, perforated for ventilation.
E. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
F. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed or shop cut and factory mitered to required angles. Back brace mitered internal corners with _____inch thick sheet.
G. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system or formed as detailed.

H. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type or finish.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

A. Fabricate of same material and finish as roofing metal.
B. Form gutters and downspouts of square profile and size to collect and remove water. Fabricate with connection pieces.
C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.
B. Exterior Surfaces of Wall or Roof Components and Accessories: Precoated enamel on steel as selected from manufacturer's standard range.
C. Interior Surfaces of Wall or Roof Components and Accessories: Precoated enamel on steel as selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

A. Erect framing in accordance with AISC 360.
B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing.
C. Set column base plates with non-shrink grout to achieve full plate bearing.
D. Do not field cut or alter structural members without approval.
E. After erection, prime welds, abrasions, and surfaces.

3.3 ERECTION - WALL AND ROOF PANELS

A. Install in accordance with manufacturer's instructions.
B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
C. Fasten cladding system to structural supports, aligned level and plumb.
D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
E. Provide expansion joints where indicated.
F. Use concealed or exposed fasteners.
G. Install insulation.
H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
B. Apply bituminous paint on surfaces in contact with cementitious materials.
C. Slope gutters minimum _____inch/ft.

D. Install splash blocks under each downspout.

3.5 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

A. Install door frames, doors, and overhead doors in accordance with manufacturer's instructions.

3.6 TOLERANCES

A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION 13 34 19

This page intentionally left blank

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 SUMMARY

A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.

C. All materials and distribution, and utilization equipment shall be UL Listed.

D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

1.4 QUALIFICATION OF CONTRACTORS

A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.

B. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.5 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:

1. The International Fire Prevention Code
2. The International Building Code
3. National Fire Protection Association (NFPA) Standards:
   a. NFPA 101 - Life Safety Code
   b. NFPA 13 - Installation of Sprinkler Systems
   c. NFPA 14 - Installation of Standpipe and Hose Systems
   d. NFPA 20 - Installation of Centrifugal Fire Pumps
   e. NFPA 24 - Installation of Private Fire Service Mains
   f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
   g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems

B. Factory Mutual (FM) Approval Guide

C. Underwriters Laboratories Inc. (UL)

D. Owner’s Insurance Underwriter Requirements

1.6 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper

operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

D. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.7 WORK INCLUDED

A. Code compliance, research, design coordination, and installation or a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and sate regulations, and these specifications.

B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.

C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.

D. All permits and approvals of the fire protection system.

E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
1. Access Panels
2. Floor, Wall, and Ceiling Plates
3. Insulation
4. Heat Trace
5. Piping and Equipment Identification
6. Painting

1.8 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.

C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.

D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.

E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.

H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.

I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.9 DRAWINGS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference

between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS

A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.

B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.

C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.11 SUBSTITUTIONS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.

D. **No substitutions will be considered after the Award of Contract.**

E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:

1. Product data, drawings and descriptions of products, fabrication and installation procedures.
2. Samples, where applicable or requested.
3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
5. A statement indicating the effect the substitution will have on the Contractor’s Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
6. Cost information, including a proposal of the net change, if any in the Contract Sum.
7. Certification by the Contractor to the effect that, in the Contractor’s opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor’s waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer’s re-design and evaluation costs resulting from the use of the proposed substitution

F. Condition: The Contractor’s request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.12 SUBMITTALS

A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

B. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

C. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.

D. Fire Protection shop drawings shall include all data required by NFPA Section 13. Prepare at one-quarter (0.25) inch scale or larger shop drawings per building area. Provide larger scale at locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Shop drawings shall be dimensioned with dimensions to be referenced from column lines. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:
   1. Fire pump and controller
   2. Jockey pump and controller
   3. Fire department valves
   4. Sprinkler heads and accessories
   5. Siamese Fire Department connection
   6. Fire valve cabinets
   7. Test header
   8. Backflow preventer
   9. Cutting oil indicating compatibility with the CPVC sprinkler piping

E. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:

   1. Pipe and fittings
   2. Valves
   3. Pipe supports
   4. Pipe accessories
   5. Pipe labels and valve tags
   6. Flow switches
   7. Tamper switches

F. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the

item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.

G. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.

H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.13 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.14 INTERFERENCE DRAWINGS

A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.

B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.15 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.16 PRECONSTRUCTION CONFERENCE

A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.17 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.18 GUARANTEE

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.19 SPARE EQUIPMENT

A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
   1. Facilities with less than 300 sprinklers – 6 minimum
   2. Facilities with 300 to 1000 sprinklers – 12 minimum
   3. Facilities with over 1000 sprinklers – 24 minimum

1.20 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

B. The original set of “as-built” drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.

C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a

condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).

1. Number of Copies: Submit one set of marked up record prints.
2. Number of Copies: Submit copies of record Drawings:
   a. Initial Submittal:
      1) Submit PDF electronic files of scanned record prints and one of file prints.
      2) Submit record digital data files and one sets of plots.
      3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
   b. Final Submittal:
      1) Submit PDF electronic files of scanned record prints and three sets of prints.
      2) Submit record digital data files and three sets of record digital data file plots.
      3) Plot each drawing file, whether or not changes and additional information were recorded.

D. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents
2. Remove Engineer's seal, name, address and logo from drawings.
3. Mark documents AS-BUILT DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY.
5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground plumbing and flow line elevations.
7. Indicate exact location of all underground mechanical piping and elevations.
8. Indicate exact location of all underground electrical raceways and elevations.
9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.21 START-UP-SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including fire pumps, jockey pumps, break tanks, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.22 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:

1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All sprinkler system equipment is to be UL Listed or FM Approved.

2.2 ACCESS PANELS

A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.

B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.

C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 FLOOR, WALL & CEILING PLATES

A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.4 GALVANIC PROTECTION

A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

2.5 INSULATION

A. The following shall be insulated:
   1. All fire suppression water piping above grade (outdoor).
   2. All fire suppression water piping above grade (un-condition space).
   3. Acceptable manufacturers:
      a. Manville Corporation.
      b. Certain-Teed.
      c. Owens Corning Fiberglass.
      d. Knauf Insulation.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
   1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
   2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
   3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades
      a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
      b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
      c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
   6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
   7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
   1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.

2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

G. Field-Applied Jackets:
1. General: ASTM C 921, Type I, unless otherwise indicated.
2. Foil and Paper Jacket: Not acceptable.
3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. PVC Jacket Color: White.
c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
d. Not to be used for outdoors.
4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
c. Not to be used for outdoors.
5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.
6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Accessories and Attachments
1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.

I. Vapor Retardants
1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 PIPING SYSTEMS IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:

1. All above ground fire protection standpipe and sprinkler piping

2. All above ground sprinkler drainage piping

B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
1. Sprinkler piping
2. Dry Sprinkler piping
3. Drain piping
4. FDC piping

C. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.

D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.

E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.

F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.

G. Valve tags will include an “FP” lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Fire Protection systems. All valves on pumps shall be similar to the valve tags specified above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.

H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.

I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.7 EQUIPMENT LABELING

A. All equipment shall be labeled. This shall include all fire pumps, jockey pumps, break tanks, and other similar equipment.

B. Equipment labeling shall be one of the following, unless noted or specified otherwise.

1. Permanently attached plastic laminate signs with 1" high lettering.
2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.8 PAINTING

A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.

B. All piping exposed to corrosive environment such as pool areas, pool equipment room, sanitization room, and acid room shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect

C. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.

C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.

D. All equipment and materials shall be installed according to manufacturer’s recommendations and shall meet the requirements of NFPA and the Owner’s Insurance Underwriter.

E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.

F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.

G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.

H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.

I. Provide a pressure gauge at the top level of all standpipes.

J. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.

K. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24” above any finished ceiling.

L. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.

M. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.

N. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.

O. Building shall be 100 percent fully sprinklered.

P. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.

Q. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

R. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5” and 2.5” fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.

S. Maintain a minimum 3’ horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.

T. Provide protection in all gymnasium areas.

U. If a deluge system in required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 PREPARATION

A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.4 SLEEVES AND ESCUTCHEONS

A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.

C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.

D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.

E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.

G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.

H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.

I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer’s approval.

J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.

K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.

L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

3.5 CLEANING

A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.

B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.

C. Remove all trash and debris from site and dispose of legally.

D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.6 DEMONSTRATION

A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.

B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.

C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.

D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.

E. Complete set of as-built drawings (Per NFPA) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.

F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.

G. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 13 at time of acceptance of test.

H. Inspections test to be piped into nearest drain to support flow.

3.7 PAINTING

A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.

B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

3.8 WORKMANSHIP

A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.

E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.9 ERECTION AND INSTALLATION

A. Installation and workmanship requirements are specified hereinafter.

B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.10 TESTS

A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

3.11 INSTRUCTION OF OWNER’S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
   1. Provide the training during the Owner's regular working day.
   2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 8 hours dedicated instructor time.
   2. 4 hours on each of 2 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect/Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, arid the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operation and Maintenance Manual”:

3.12 OPERATION AND MAINTENANCE MANUALS

A. Form of Manuals:
   1. Prepare data in form of an instructional manual for use by Owner's personnel.
   2. Format:
      a. Size: 8-1/2" x II".
      b. Text: Manufacturer's printed data or neatly typewritten
   3. Drawings:
      a. Provide reinforced punched binder tab and bind in text.
      b. Fold larger drawings to size of text pages.

4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
   a. Title of Project
   b. Identity of separate structures as applicable.
   c. Identity of general subject matter covered in the manual
6. Binder as specified.

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
   a. Contractor, name of responsible principal, address and telephone number.
   b. A list of each product required to be included, indexed to content of the volume.
   c. List with each product, name, address and telephone number of:
      1) Subcontractor or installer
      2) Maintenance contractor as appropriate.
      3) Identify area of responsibility of each
      4) Local source of supply for parts and replacement
   d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
   a. Include those sheets pertinent to the specific product.
   b. Annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems.
      2) Control and flow diagrams.
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
4. Written text, as required to supplement product data for the particular installation:
   a. Organize in consistent format under separate headings for different procedures.
   b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in event of failure.
      2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts
   b. Operating procedures:
      1) Start up, break-in, routine and normal operating instructions.
      2) Regulation, control, stopping, shut down and emergency instructions.
      3) Summer and winter operating instructions.

4) Special operating instructions
c. Maintenance procedures:
1) Routine operations
2) Guide to trouble-shooting.
3) Disassembly, repair and reassembly.
4) Alignment, adjusting and checking.
5) Routine service based on operating hours.
d. Servicing and lubrication schedule. List of lubricants required.
e. Manufacturer's printed operating and maintenance instructions.
f. Description of sequence of operation by control manufacturer
g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
1) Predicted life of part subject to wear.
2) Items recommended to be stocked as spare parts.
h. As installed control diagrams by controls manufacturer.
i. Complete equipment internal wiring diagrams.
j. Each Contractor's coordination drawings.
k. As installed color coded piping diagrams.
l. Charts of valve tag number, with location and function of each valve.
m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
n. Other data as required under pertinent sections of the specifications.

2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.

END OF SECTION 21 05 00

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 DESCRIPTION

A. This section describes the following:
1. Hangers, supports and anchors for the fire protection equipment, tanks and piping systems.
2. Supplementary steel for support or attachment of fire protection tanks, equipment and piping to general construction elements of the project.

1.3 REFERENCES

A. General:
1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.

B. Code of Federal Regulations 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).

C. National Fire Protection Association (NFPA) Standards:
1. NFPA 101 - Life Safety Code
2. NFPA 13 - Installation of Sprinkler Systems
3. NFPA 14 - Installation of Standpipe and Hose Systems
4. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems

D. Factory Mutual (FM) Approval Guide

E. Underwriters Laboratories Inc. (UL)

F. Owner’s Insurance Underwriter Requirements

1.4 SUMMARY

A. Provide a complete system of pipe hangers and supports for all fire protection equipment and piping.

B. Section Includes:
1. Pipe, equipment hangers and supports.
2. Anchors, equipment bases and supports.
3. Sleeves and seals.
4. Firestopping.

1.5 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.6 SUBMITTALS

A. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Submit calculations showing compliance with Division 01 Section "Lateral Force Procedures" for seismic bracing of ductwork and piping.

1.7 QUALITY ASSURANCE

A. Comply with Division 21 Section "Common Results for Fire Suppression."

B. Supports for Sprinkler Piping: Comply with NFPA 13.

C. Supports for Standpipes: Comply with NFPA 14.

D. Do not use black steel devices, components, fasteners, etc. within the Clean Room interstitial space or in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Unistrut Corp.
2. B-Line Systems.
3. Grinnell.
4. Superstrut,
5. Anvil.

B. Pipe Supports:
1. Conform to MSS SP58.
2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal.
3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.
4. Multiple or Trapeze Hangers: 12 gauge (2.67 mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps.
5. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12 gauge channel complete with pipe clamps, nuts, bolts, and end caps.
6. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.
7. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
8. Floor Support for Pipe Sizes 6 Inches (152.4 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 ATTACHMENT TO STRUCTURE

A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. Connection to Existing Concrete Structure: Concrete anchors conforming to Division 03 Section “Concrete Accessories”.

C. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.

D. For Support on New Concrete: Galvanized steel headed bolts.

E. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.

F. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

2.4 SUPPORTS, BRACING, AND ACCESSORIES

A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.

B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.

C. Sheet Metal Screws: Plated, size 10 minimum.

D. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.

2.5 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel.

B. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Provide stainless steel sheet metal for exterior walls.

C. Sealant: Acrylic

2.6 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc., or approved equal.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

A. Manufacturers:
1. Unistrut Corp., or approved equal.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp. Model.
2. 3M fire Protection Products Model.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray or Black. As selected from manufacturer’s full range of colors. Coordinate different color(s) with Architectural elements where required if exposed to view.

2.9 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing or damming materials to arrest liquid material leakage.

D. Do not drill or cut structural members.

E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.

F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with MSS SP 58.

B. Install hanger spacing and provide hanger diameter for the given pipe size accordance with the requirements of NFPA.

C. Beam clamps shall only be used on beams. It is acceptable to use clamps on the top cord of the joist within 3” of the panel point but never on the bottom cord of the joist at any location. It is also acceptable to route a vertical all-thread thru the middle of the joist.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation.

K. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.

F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.

D. Fire Rated Surface:
1. Seal opening at floor and wall as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
   b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

E. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
   a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
   b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.

c. Install type of sealant or caulk suitable for application.

2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 21 05 29

SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

D. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS

1.2 DEFINITIONS

A. IBC: International Building Code.

1.3 PERFORMANCE REQUIREMENTS

A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.

B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.

D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.

E. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.

F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs./sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.

H. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.

I. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.

J. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.

K. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
   1. Offices
      a. Executive: 30
      b. Conference rooms: 30
      c. Private: 35
      d. Open-plan areas: 35
      e. Computer/business machine areas: 40
      f. Public circulation: 40

   2. Schools
      a. Lecture and classrooms: 30
      b. Open-plan classrooms: 35

   3. Libraries: 25
   4. Theaters
      a. Theater: 25
      b. Stage house: 25
      c. Trap room: 25
      d. Orchestra pit: 25
      e. Rehearsal rooms: 25
      f. Teaching studios: 30
      g. Practice rooms: 30
      h. Ensemble rooms: 30
      i. Shop: 45

1.4 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

H. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. All fire suppression systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

A. All vibration isolators described in this section shall be the product of a single manufacturer. . Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.
1. Manufacturers:
   a. Mason Industries
   b. Kinetics Noise Control
   c. Amber / Booth
   d. Vibration Eliminator

B. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the

equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

C. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.

D. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

E. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.

F. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.

G. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

H. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

I. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

J. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.

C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2

inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS

A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14"shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14"shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2"thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

2.4 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1” inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Locate isolation hangers as near the overhead support structure as possible.

D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.

F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.

H. Install cables so they do not bend across edges of adjacent equipment or building structure.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least **four** of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 21 05 48.13

SECTION 21 11 13 - FIRE SUPPRESSION SYTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

E. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.

D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

E. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.

F. Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.

G. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.3 WORK INCLUDED

A. Code compliance, research, design coordination, and installation or a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and sate regulations, and these specifications.

B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.

C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.

D. All permits and approvals of the fire protection system.

1.4 SYSTEMS

A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.

1. Pipes, fittings, and specialties
2. Standpipe systems
3. Automatic Sprinkler Systems
4. Automatic Dry Sprinkler Systems
5. Fire Department Valve Cabinets

1.5 GUARANTEE

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.1 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:

1. The International Fire Prevention Code
2. The International Building Code
3. National Fire Protection Association (NFPA) Standards:
    a. NFPA 101 - Life Safety Code
    b. NFPA 13 - Installation of Sprinkler Systems
    c. NFPA 14 - Installation of Standpipe and Hose Systems
    d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems

B. Factory Mutual (FM) Approval Guide

C. Underwriters Laboratories Inc. (UL)

D. Owner's Insurance Underwriter Requirements

1.2 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

1.3 DESIGN CRITERIA

A. Any design documents issued to the contractor are for information only. The Contractor shall be responsible for all code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. The Contractor shall arrange for, and conduct a flow test and coordinate its validity with the Authorities Having Jurisdiction.

B. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to the Engineer for confirmation of the existing water service.

C. Where pre-design of the sprinkler system is required for submission for the building permit: The Fire Protection documents were prepared to be in compliance with all applicable codes and flow test data provided. The Contractor shall review all documents provided and report any modifications required to these documents to the Design Engineer during the shop drawing preparation stage.

D. All sprinkler heads in occupied areas are to be fast response type heads (155 degrees – 165 degrees Fahrenheit).

E. All occupied, heated spaces will be protected by wet sprinkler systems.

F. Inspector test valves will be protected by wet sprinkler systems.

G. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
   1. NFPA 13 Systems

Area/ Usage	Hazard Classification	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Public Spaces, Lobbies, Corridors, Offices, Restaurants, Lounges, Meeting Rooms	Light	.10	1,500 sq. ft.	130-200 sq.ft.	100 gpm
Dry Pipe System:	Light	.09	1,950 sq. ft.	130-200 sq.ft.	100 gpm
Mechanical Rooms, Electrical Rooms, Elevator Equipment Rooms, Maintenance/ Storage Rooms, Kitchen/ Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System: Parking Garages, Non-heated Attic Spaces, Ceiling Spaces, Porte Cochere and other spaces containing sprinkler piping that do not have alternate provisions to guarantee a 40° F temperature.	Ordinary Group 1	.14	1,950 sq. ft.	130 sq. ft.	250 gpm
Ballrooms, exterior loading docks, distilleries, barns and stables, dry cleaners, libraries, machine rooms, and auto repair shops.	Ordinary Group 2	.20	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System:	Ordinary Group 2	.19	1,950 sq. ft.	130 sq. ft.	250 gpm
Upholstery shops, sawmills, plywood manufacturers, or textile factories, Low-pilled storage, dust or lint generated areas, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper.	Extra Hazard Group 1	.30	2,500 sq. ft.	90-130 sq. ft.	500 gpm
Plastic manufacturing operations, steel manufacturing, and automobile paint spray booths, Space with high combustible or flammable liquids, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper	Extra Hazard Group 2	.40	2,500 sq. ft.	90-130 sq. ft.	500 gpm

H. Available fire-hydrant flow test records indicate the following conditions:
   1. Refer to the fire protection cover sheet.

I. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.

J. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.

K. Coordination:
   1. The Fire Protection Contractor shall review the complete set of project documents and coordinate his work with all other trades involved.
   2. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Locations of sidewall heads shall be coordinated with architectural interior elevations.
   3. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, and ductwork.

L. Sprinkler Systems
   1. Any design documents issued to the Contractor are for information only. The Contractor shall be responsible for the actual layouts, general routing of piping and additional sprinkler heads to meet all requirements.

M. All underground mains and appurtenances are to be installed according to NFPA 24.

N. Fire Protection System Alarms

   1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
   2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
   3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
   4. Upright automatic sprinklers will be provided in all elevator shafts and elevator machine rooms. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

1.4 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.5 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.6 PRECONSTRUCTION CONFERENCE

A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.7 SUBMITTALS

A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

B. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.

C. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor

shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:

1. Fire department valves
2. Sprinkler heads and accessories
3. Siamese Fire Department connection
4. Fire valve cabinets
5. Test header
6. Backflow preventer
7. Cutting oil indicating compatibility with the CPVC sprinkler piping

D. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:

1. Pipe and fittings
2. Valves
3. Pipe supports
4. Pipe accessories
5. Pipe labels and valve tags
6. Flow switches
7. Tamper switches

E. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.

F. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.

G. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.8 SPARE EQUIPMENT

A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
1. Facilities with less than 300 sprinklers – 6 minimum
2. Facilities with 300 to 1000 sprinklers – 12 minimum
3. Facilities with over 1000 sprinklers – 24 minimum

PART 2 - PRODUCTS

2.1 GENERAL

A. All sprinkler system equipment is to be UL Listed or FM Approved.

B. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

C. Manufacturers.
1. Pipe.
   a. Wheatland Tube
   b. Youngstown Tube Company
   c. Bull Moose Tube
   d. Paragon
2. Sprinkler and Alarm Valve.
   a. Viking Corp
   b. Globe Fire Sprinkler Corp
   c. Tyco
   d. Reliable
   e. Victaulic Company
3. Valve
   a. Milwaukee
   b. NIBCO
   c. Bray
   d. Mueller Co
   e. Tyco Fire
   f. Victaulic Company
   g. Crane
4. Specialty Valve
   a. Potter-Roemer
   b. Croker
   c. Guardian Fire Equipment
   d. Elkhart Brass Mfg
   e. Tyco Fire

D. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.

E. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.

F. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 MATERIALS

A. All piping shall be made in the USA and be labeled according to City and /or State manufacturers. Pipe shall be protected with MIC shield coating.

B. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.

C. In-Building Riser: At incoming below grade fire water service entry for pipe sizes 4" and larger, provide a 90-degree jointless ASTM A312 304 stainless steel in-building riser by Ames Fire & Waterworks Series IBR. Lead-free, NSF approved for potable water

supply, UL Listed, FM Approved, NFPA 24, AWWA C900 inlet/DIP, AWWA C606 outlet. Provide concrete thrust block at 90-degree change of direction. Provide custom length as required where standard 6'-0" length does not extend past building perimeter wall.

D. Pipe and Fittings:
1. Piping – Schedule 40 ASTM A-53, A-795, A-135, black steel piping for branches (1 inch – 2 inches) and schedule 10 ASTM A-53, A-795, A-135 (2-1/2 inches – 8 inches) black steel for mains.
   a. Piping (piping only, excluding fittings) for dry systems shall be Schedule 40 ASTM 53 galvanized steel in all pipe sizes, screwed galvanized cast or malleable iron fittings through 2", grooved couplings for 2-1/2" and larger pipe sizes.
   b. Buried Water Service Entrance Piping.
      1) Pipe - Cement mortar lined ductile iron.
      2) Fittings – Cement mortar lined ductile iron using mechanical joints.
      3) Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.
      4) All pipe and fittings shall be encased with polyethylene film having a minimum thickness of 8 mils.
2. Fittings under 2-1/2 inches screwed cast iron, 175-pound S.W.P., 2-1/2 inches and larger, flanged, or grooved pipe and fittings to accept a bolted type clamp with gasket.
3. Grooved Couplings & Fittings: ductile iron with gasket and two bolts, 300 psi working pressure. Victaulic, Firelock fittings.
4. Flanges – cast iron, 175 pound S.W.P., with threaded inlet, or Victaulic Mod. #741.
5. Hangers to meet NFPA 13 spacing and type.

E. Control Valves: All control valves are to be electrically supervised. A pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
1. 2-1/2 inches and under – 175 psi, Milwaukee "Butterball" with built-in tamper switches.
2. Over 2-1/2 inches – UL listed and FM approved, 175 psi, butterfly valves or OS&Y with tamper switch.
3. All butterfly valves shall have a built in tamper resistant switch for supervision of the open position. The switch shall be contained within a NEMA Type 1, general purpose indoor rated housing. Either unauthorized removal of the switch housing (when the valve is open) or closing the valve, shall cause the switch contacts to change position. The switch shall have four conductors to accommodate connections to Style 4 or Style 6 signaling line circuit devices.

F. Check Valves:
1. Check valves 2-1/2 inches and larger shall be iron body swing check with cast brass hinge, rod, and brass faced discs.
2. Check valves 2 inches and smaller shall be UL listed brass body and all brass fitted.

G. Alarm Check Valves: Shall be for vertical installation, cast iron, complete with retard chamberport to alarm, pressure gauges, main drain, electric alarm pressure switch with dual contacts suitable for either open or closed circuit.
   1. Control valve, check valve, and pressure or flow switch tied to fire alarm system and sprinkler alarm bell.
      a. 2-1/2" to 3, Class 150, iron body, bronze disc, flanged or groove ends, TYCO Fire Products LP; AV-1-300, UL Listed for fire service.
      b. 4" and larger, Class 150, iron body, bronze trim, flanged ends, TYCO Fire Products LP; AV-1-300, flanged, UL Listed for fire service.

H. Switches:
   1. Water Flow Switches: Shall be paddle type water flow alarm (or pressure switch of retard chamber) and with double contacts for either open or closed circuit operation for connection to building fire alarm system.
   2. Tamper Switches: Shall be designed as an integral part of control valve assembly or tamper switch shall have double acting, spring loaded plunger to activate a single-pole double-throw switch for valve supervision of OS&Y type control valves.

I. Fire Department Connections (as indicated on plans):
   1. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
   2. Free Standing: Potter Roemer 5760 series or approved equal.

J. Sprinkler Head Escutcheons.
   1. Finish for all escutcheons shall match the finish of sprinkler heads on which they are used. Use white cover plates for white painted soffits and white acoustical ceiling tile, black cover plates for black lay-in acoustical ceiling tile, custom color to match specialty ceilings.

K. Water Motor Gong
   1. Provide a water motor gong. No Electric Bell.

2.3 AUTOMATIC SPRINKLER SYSTEM MATERIALS

A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.

B. Automatic sprinklers shall be provided as follows:
   1. Public Spaces with Gypsum and Lay-in Ceilings
      a. Fully concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings and lay-in ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Ceiling coverplate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Tyco, Reliable, Victaulic or Viking Horizon Mirage concealed sprinkler or approved equal.
   2. Back-of-House Spaces and Unfinished Spaces with no Ceiling

a. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless conditions require higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Tyco, Reliable or Viking Microfast Model M.

3. Exterior Overhangs and Elevator Shafts
   a. Standard response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Viking Model M.

C. Flexible sprinkler connections are permitted and shall be fully braided, corrugated 300-series stainless steel hose with 300-series stainless steel braid, minimum 1” internal diameter. Provide compatible multiport bracket and adjustable hub as required for manufacturer recommended installation. Contractor shall adhere to manufacturer installation requirements for the flexible connection minimum bend radius. Product shall be UL or FM Approved.
   1. Acceptable manufacturers:
      a. Victaulic VicFlex Series
      b. Anvil SuperFlex Series

D. All outdoor sprinkler heads shall be wax coated.

E. Alternate acceptable manufacturers with equivalent sprinklers are Automatic, Central, Anvil International, Gem and Reliable.

F. Sprinkler guards shall be installed on all sprinklers 7'-0" or less above floor.

G. Provide sprinklers at the highest and lowest level of all stairwells.

H. Provide sidewall sprinklers at the top end and bottom of all elevator hoistways. Sprinklers may be omitted from traction elevators on non-combustible elevator shafts and cabs which meet the requirements of ASME A.17.1 and where acceptable to the local authorities.

I. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.

J. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.

K. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.

L. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.

M. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.

N. Provide sprinkler connections to all required food service hood suppression systems.

O. Sprinkler guards shall be installed on all sprinklers located in cafeteria and the gym.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.

C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.

D. All equipment and materials shall be installed according to manufacturer’s recommendations and shall meet the requirements of NFPA and the Owner’s Insurance Underwriter.

E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.

F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles. For every sprinkler head, tap main/branch pipe serving each individual sprinkler head shall come from the top of pipe to prevent trash from collecting at head. (**Piping laterals to a sprinkler head is FORBIDDEN off the bottom of the main or lateral piping system**).

G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.

H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.

I. Dry pipe systems shall be specified as installed with the longitudinal weld seam located above the horizontal centerline of the pipe, and with drain valves installed at all low points regardless of trapped water volume. Require that mains and branch lines be pitched at least 1 /2 in. per 10 ft in all locations, including in non-refrigerated areas (areas not subject to freezing).

J. Provide a pressure gauge at the top level of all standpipes.

K. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.

L. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24” above any finished ceiling.

M. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.

N. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, gymnasium areas, storage rooms and all unfinished areas where the head is less than 7 feet-0 inches above finished floor.

O. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.

P. Building shall be 100 percent fully sprinklered.

Q. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.

R. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

S. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5” and 2.5” fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.

T. Maintain a minimum 3’ horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.

U. If a deluge system in required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 CLEANING

A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.

B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.

C. Remove all trash and debris from site and dispose of legally.

D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.4 TESTS

A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

END OF SECTION 21 11 13

SECTION 21 30 00 – FIRE PUMP AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.

C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

E. SECTION 21 11 13 – FIRE SUPRESSION SYSTEMS.

F. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

1.3 WORK INCLUDED

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.

E. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.

F. All permits and approvals of the fire protection system.

1.4 SYSTEMS

A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.

1. Split-case fire pump.
2. Fire pump accessories and specialties.
3. Flowmeter systems.
4. Pressure Booster (Jockey) pump.
5. Electric Fire Pump Controller.

1.5 QUALIFICATION OF CONTRACTORS

A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.

B. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.6 GUARANTEE

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.7 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:

1. The International Fire Prevention Code
2. The International Building Code
3. National Fire Protection Association (NFPA) Standards:
   a. NFPA 101 - Life Safety Code
   b. NFPA 13 - Installation of Sprinkler Systems
   c. NFPA 14 - Installation of Standpipe and Hose Systems
   d. NFPA 20 - Installation of Centrifugal Fire Pumps
   e. NFPA 24 - Installation of Private Fire Service Mains
   f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems

B. Factory Mutual (FM) Approval Guide

C. Underwriters Laboratories Inc. (UL)

D. Owner's Insurance Underwriter Requirements

1.8 ORDINANCES, PERMITS AND DRAWING APPROVALS

A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.

B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.

C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.9 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.10 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials

received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.11 PRECONSTRUCTION CONFERENCE

A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.12 SUBMITTALS

A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

B. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.

C. Seismic Qualification Certificates: For fire pumps, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each fire pump, from manufacturer.

E. Source quality-control reports.

F. Field quality-control reports.

G. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.

H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

PART 2 - PRODUCTS

2.1 GENERAL

A. Description: Factory-assembled and -tested fire-pump and driver unit.

B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

D. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.

E. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.

F. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 FIRE PUMP

A. Electric motor driven fire pump with jockey pump and electric controllers.

B. The fire pumps shall be designed to deliver the capacity necessary to comply with NFPA 13 and NFPA 20 and to provide a complete, code compliant pumped fire protection system. Fire pumps shall furnish not less than 150 percent of rated capacity at not less than 65 percent of total rated head. The shutoff head shall not exceed 120 percent of total rated head.

C. Manufacturers:

1. Armstrong
2. Aurora
3. Peerless
4. Fairbanks-Morse
5. Patterson Fire Pump

D. Horizontal Base Mounted Pumps:
1. Type: UL 448 horizontal shaft, single stage, double suction, direct connected, horizontally split casing for 250 psig maximum working pressure.
2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Bearings: Grease lubricated ball bearings, replaceable without opening casing.
5. Shaft and sleeve: Alloy steel with replaceable bronze shaft sleeve.
    a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

c. Seal: Packing gland with minimum four rings graphite impregnated packing and bronze lantern rings, 230 degrees F maximum continuous operating temperature.

6. Drive: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.
7. Baseplate: Cast iron with integral drain rim.

E. Electric Motor Drive
1. Motor: Standard UL 1004A, squirrel cage induction type; in open drip proof NEMA MG-1 enclosure, 1750 rpm.
2. Electrical Characteristics:
a. Volts: **460**
b. Phase: Three.
c. Hertz: 60

2.3 FIRE PUMP ACCESSORIES AND SPECIALTIES

A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.

B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

C. Relief Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
a. BERMAD Control Valves.
b. CLA-VAL Automatic Control Valves.
c. OCV Control Valves.
d. Watts Regulator Company; a division of Watts Water Technologies, Inc.
2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.

D. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.

E. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

F. Hose Valve Manifold Assembly:
1. Standard: Comply with requirements in NFPA 20 and NFPA 25.
2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: UL 1726.
5. Manifold:
a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
e. Escutcheon Plate: Brass or bronze; rectangular.
f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.

g. Exposed Parts Finish: c**hrome plated**.
h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST.

6. Manifold:
a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
b. Body: Exposed type, brass, with number of outlets required by NFPA 20.
c. Escutcheon Plate: Brass or bronze; round.
d. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads. Include caps and chains.
e. Exposed Parts Finish: [Polished] [Rough] [brass] [, chrome plated].
f. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 FLOWMETER SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Emerson Process Management; Rosemount Division.
2. Fire Research Corp.
3. Gerand Engineering Co.
4. Hydro Flow Products, Inc.
5. Hyspan Precision Products, Inc.
6. Meriam Process Technologies.
7. Preso Meters; Division of Racine Federated Inc.
8. Reddy-Buffaloes Pump Company.
9. Victaulic Company.

B. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

C. Pressure Rating: **175 psig (1200 kPa) minimum**

D. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.

E. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting.
1. Tubing Package: NPS 1/8 or NPS 1/4 (DN 6 or DN 10) **soft copper** tubing with copper or brass fittings and valves.

F. Portable Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter and with two 12-foot- (3.7-m-) long hoses in carrying case.

2.5 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink and recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 PRESSURE BOOSTER (JOCKEY) PUMP

A. Electrically operated, horizontal close-coupled type with standard open drip-proof horizontal motor.

B. Each pump shall be multistage bronze fitted turbine type with bronze impeller, stainless steel shaft, and grease-lubricated ball bearings, similar and approved equal to Aurora Series 11 0.

C. The fire system jockey pump shall be furnished with a factory-mounted bypass relief valve complete with piping. Set relief pressure above the design total dynamic head as required to prevent motor overload and damage to the system.

D. Control by automatic jockey pump controller with full voltage starter and minimum run timer to start pump on pressure drop in system and stay in operation for minimum period of time. Fire pump shall start automatically on further pressure drop or on jockey pump failure.

E. The jockey pump control panel enclosure shall be NEMA 3R wall-mounted, factory assembled, wired, and tested and shall be finished with a baked enamel coating. Panel shall include at least the following equipment:
1. One non-fused disconnect switch mounted on panel door.
2. One combination magnetic motor controller.
3. One hand-off-automatic selector switch mounted on panel door.
4. 120 volt control power transformer and fused disconnect switch as required to operate switches and controls in the panel.

F. The jockey pump controller shall be manufactured by Metron, Firetrol, Sylvania/Clark or Master.

2.7 ELECTRIC FIRE PUMP CONTROLLER

A. The electric fire pump controller shall be manufactured by Metron, Firetrol, Sylvania/Clark or Master.

B. The fire pump controller shall be UL/FM approved for automatic and manual start and UL Labeled for service entrance. Controller shall have a NEMA 2 enclosure, 100,000 AIC circuit breaker, disconnect, wye-delta closed transition starter, automatic transfer switch, pressure control, minimum run timer, pilot light, start-stop push buttons, manual operator, alarm relays, sequence start timer, phase reversal monitor, alarm bell and lights, fused power control transformer, and remote annunciator all as required by and in accordance with NFPA 20 and Electric Code, NFPA 70 and include the following:
1. The locked rotor overcurrent protection shall be provided by a separate overcurrent monitor of the microprocessor type, set at 300 percent of motor full load current and shall have a trip time between 8 and 20 seconds at 600 percent of motor full load current.
2. Isolation switch with single external operating handle interlocked with circuit breaker. Operating mechanism shall be flange or side mounted.
3. Nonfused control power transformer.
4. START and STOP pushbuttons for manual control.
5. Ammeter test links and voltmeter test studs.

6. POWER AVAILABLE pilot light to indicate power on the load side of the circuit breaker and PHASE REVERSAL pilot light for the line side of the motor starter. Pilot lights shall be mounted externally.
7. Surge protector wired to the line side of the isolation system.
8. Solid state pressure switch and transducer with energize to start relay. Pressure switch shall be differential adjustable type with LED indicators for trip and reset. NOTE: Pressure switches in systems exceeding 175 psi shall have a range from 0 to 600 psi.
9. Minimum run time, adjustable 0 - 10 minutes with timed-out LED indicator. Per NFPA 20 and FM pump should be arranged for “manual stop” the run-timer and auto stop function must be disabled.
10. Magnetic contactors with externally operable mechanical start mechanism.
11. Two sets each of dry form "C" contacts for remote indication of PUMP RUNNING, POWER FAILURE and PHASE REVERSAL.
12. The electric fire pump controller shall also include an automatic start relay of the drop-out type, and a local built-in alarm panel powered from a separate reliable 120 VAC power source.
13. The local alarm panel shall have individual indicating lights with a common alarm bell and silence button for POWER FAILURE, PUMP RUNNING, PHASE REVERSAL, LOW DISCHARGE PRESSURE, TRANSFER SWITCH IN EMERGENCY, ISOLATION SWITCH OPEN and REMOTE START.
14. A local indicating light and two sets of remote alarm contacts shall be furnished to monitor SUPERVISORY POWER of the local alarm panel.
15. Two sets of dry form "C" remote alarm contacts shall be provided for LOW DISCHARGE PRESSURE, TRANSFER SWITCH IN EMERGENCY and ISOLATION SWITCH OPEN.
16. A separate pressure switch shall be supplied to monitor discharge pressure.
17. All indicators shall be illuminated from the rear by long life LED lamps. Incandescent lamps are not acceptable

C. ***The fire pump controller shall be factory assembled, wired and tested [with an Automatic Transfer Switch (ATS) listed by Underwriters' Laboratories, Inc. for transfer switch and fire pump controller service,] and shall conform with NFPA 20 and NFPA 70 and be in accordance with [UL 1008 and] UL 508. Ammeter test links and voltmeter test studs shall be provided in the enclosure and a two-position pushbutton marked "START-STOP" and an emergency start handle shall be provided on the enclosure.***

D. ***The automatic transfer switch shall be wired to the fire pump controller and mounted in a separate compartment with an isolation barrier. The automatic transfer switch shall include an isolation switch and externally operable handle, voltage and frequency sensitive relays for normal power, voltage and frequency sensitive relays for emergency power sensed from emergency control power transformer, normal and emergency control power transformers, and time delays for ENGINE START, TRANSFER TO EMERGENCY, RETRANSFER TO NORMAL and ENGINE COOLDOWN. The transfer switch shall also include provisions for preventing higher than inrush currents when transferring power in either direction, a TEST switch and pilot lights for NORMAL POWER and EMERGENCY POWER***.

E. A remote annunciator panel shall be furnished and installed by this Division in the Fire Command Center and shall be wired to the fire pump controller by Division 26. The remote annunciator shall be flush mounted and shall have an audible alarm with silence pushbutton and indicator lights for "Fire Pump Running", "Loss of Main Power", "Phase Reversal", **["Emergency Isolation Switch Off"]** and "Low Discharge

Pressure". **[The remote alarms shall also have alarm output contacts for monitoring of fire pump trouble and run alarms by the Fire Alarm System specified under Division 28] [and the Building Control and Automation System specified [in Section 23 06 00, "Building Controls",] [under Division 23]].**

F. **Manufacturer shall provide power wiring from the pump to the controller, whether it be three, six, etc. wires.**

G. **All fire pump controller [ATS] and remote annunciator control switches and indicators shall have engraved identifying nameplates.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 MANUFACTURER'S INSTRUCTIONS

A. Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. Install in accordance with ULC listing, ANSI/NFPA 20, manufacturer's instructions and approved shop drawings.

C. Install engine cooling system.

D. Insulate exhaust system, cooling system muffler in accordance with Section 21 05 00 - Thermal Insulation for Piping.

E. Align pump and motor shafts to within manufacturer's recommended clearances prior to start-up.

F. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

G. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings or pump suction and discharge.

H. Flow meter shall discharge into atmospheric suction tank. Flow meter loop shall not circulate back to the pump suction line.

I. Locate fire pump test hose valve header on exterior wall accessible from grade level.

J. Provide piping to, and route discharge from all relief valves and drains to exterior of building and terminate at a location and in a manner to prevent any damage to surrounding areas.

K. Provide full line size bypass with double-check valve assembly around surge tank and fire pump.

L. Coordinate connection to electrical service.

M. Provide a pressure gauge at supply and suction side of fire pump.

3.4 DEMONSTRATION

A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.

B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.

C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.

D. Provide the Owner with as-built drawings and equipment data at completion of construction.

E. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 20 at time of acceptance of test.

3.5 WORKMANSHIP

A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.

E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.6 INSTRUCTIONS AND START-UP

A. Contractor shall provide for the service of a competent factory-trained supervising agent from the fire pump manufacturer to inspect the completed installation, start the system and acquaint the operators with the proper operation and maintenance of the equipment.

3.7 TESTS

A. Tests of all fire protection systems and equipment, shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

3.8 INSTRUCTION OF OWNER’S PERSONNEL

A. See related section 21 05 00.

3.9 OPERATION AND MAINTENANCE MANUALS

A. See related section 21 05 00

END OF SECTION 21 30 00

SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all work for plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

B. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc., required and/or necessary to completely install, clean, inspect, adjust, test, balance, and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.

D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

E. Unless directly specified otherwise, all noted pipe diameters herein are nominal.

1.3 QUALITY ASSURANCE

A. Perform all work in accordance with the latest edition of the applicable codes, Specifications, local ordinances, industry standards, utility company regulations, and nationally accepted codes.

B. All materials, distribution, and utilization equipment shall be UL Listed.

C. All equipment and materials shall be new, unused, of United States domestic manufacture, and comply with the Buy America Act, unless approved otherwise by the Engineer or Owner.

D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer to not be an inherent part of the systems as designed without additional cost to the Owner.

E. An approved Contractor for the work under this Division shall be:

1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.

2. Able to furnish evidence of having contracted for and installed not less than (3) systems of comparable size and type that have served their Owners satisfactorily for not less than (3) years.

1.4 WORK INCLUDED

A. Systems: Plumbing systems installed, and the work performed under this Division of the Specifications, shall include, but are not necessarily limited to, the following systems as noted below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically noted otherwise.

1. Domestic cold water, hot water, hot water recirculation systems
2. Natural gas systems
3. Primary storm drainage, secondary storm drainage systems
4. Sanitary drainage, waste, vent systems

B. Contract quality control including workmanship, manufacturer's instructions, mock-ups, and demonstrations.

1. Executing Mock-ups:
   a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals, and finishes.
   b. Do not proceed with any work involving a mock-up until the related mock-up has been approved in writing.
   c. Acceptable mock-ups in place shall be retained in the completed work.
   d. Perform tests and submit results as specified.
2. Scheduling Mock-ups: Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer for:
   a. Rough-in
   b. Finish with all appurtenances in place
   c. Insulation installed
   d. Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and Specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.

B. Provide all rigging required for complete installation and furnish Drawings showing necessary points of support, reactions, and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.

C. Become thoroughly acquainted with the work involved; obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this Division necessary for the proper installation of their Contracts. Confer with other Contractors for finish adjacent to work of this Section and arrange to have visible portions of the work (e.g., access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architect.

D. Transmit to trades doing work of other Sections all information required for work to be provided under their respective Sections (e.g., freshwater connections, foundations, electric wiring, access doors, etc.) in ample time for installation.

E. Where disagreements occur between the Plans and the Specifications, or within either document itself, the item or arrangement of better quality, greater quantity, or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this Division with all other Divisions to ensure that all components of plumbing and fire protection systems will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the plumbing and fire protection systems' components.

C. Make all plumbing and fire protection connections to all equipment furnished by this Division and as required by any other Division.

D. Electrical wiring, control equipment, and motor starters indicated on the electrical Drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the plumbing trades, either in these Specifications or on the plumbing Drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical Drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these Specifications.

E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with plumbing equipment shall have overload protection in all phases. It shall be the responsibility of each Subcontractor furnishing motors and devices to advise electrical Contractor of exact function of systems to assure proper type of starter with correct number of auxiliary contacts for proper operation of the system.

F. The plumbing trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner because of lack of such coordination.

G. The design of the electrical system(s) is based on the plumbing equipment specified and scheduled on the Drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the plumbing trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.

H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the electrical Contractor at the site for custody, erection in place, and wiring as specified.

I. Smoke detection systems shall be furnished and installed under Division 26. Coordinate locations with electrical Contractor.

1.7 DRAWINGS

A. The Drawings are schematic in nature but shows the various components of the system(s) approximately to scale and attempts to indicate how they are to be integrated with other

parts of the building. Contractor shall determine exact locations by review of equipment manufacturer's data, jobsite measurements, checking the requirements of other trades, and reviewing all Contract Documents. The size of the plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed and approved manufacturers shall be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The Drawings are not intended to show exact locations of pipes and ducts, nor to indicate all offsets, fittings, and supports, but rather to indicate approximate layout.

B. The mechanical, electrical, plumbing, and fire protection Drawings are necessarily diagrammatic in nature and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances, structural conditions, and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases, suspended ceilings, soffits, finished portions of the building, etc., unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, electrical, plumbing, and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system(s) involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

D. The locations, arrangement, and extent of equipment, devices, and other appurtenances related to the installation of the work shown on the Drawings are approximate. The Contractor shall not scale Drawings; rather, the Contractor shall refer to the Architect Drawings for exact dimensions of building components. Should a conflict exist between the Architect and Engineer Drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

E. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. The Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in these Specifications and the procedures covered by these Specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. Refer to Division 01 Specification for additional requirements.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment

for which it is to be substituted and a complete description of the proposed substitute including drawings, cutsheets, performance and test data, and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who, in their judgement, is unsuitable for use on the Project and that decision shall be final.

D. **No substitutions will be considered after the Award of Contract.**

E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request, identify the product, fabrication method, or installation method to be replaced by the substitution; include related Specifications Section(s), Drawing(s), and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate with each request, the following information:

1. Product data, drawings, and descriptions of products, fabrication methods, and installation procedures.

2. Samples where applicable or requested.

3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effect where applicable.

4. Coordination information, including a list of changes or modifications needed by other parts of the work and construction, to be performed by the Owner and separator Contractors that will become necessary to accommodate the proposed substitution.

5. A statement indicating the effect the substitution will have on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

6. Cost information, including a proposal of the net change, if any, in the Contract Sum.

7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including the Architect and Engineer's redesign and evaluation costs, resulting from the use of the proposed substitution.

9. Conditions: The Contractor's request for substitution will be received and considered when extensive revisions to the Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented, properly submitted, and when one (1) or more of the above conditions are satisfied, then the substitution

will be judged and determined by the Architect and Engineer; otherwise, the requests will be returned without action except to record non-compliance with these conditions and requirements.

1.9 SUBMITTALS

A. Provide shop drawings and complete product data as indicated in each Specifications Section.

B. Coordination drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the ductwork and piping as well as the major mechanical, plumbing, and fire protection equipment are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at one-quarter (0.25) inch scale or larger shop drawings per building area. Provide larger scale at locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Shop drawings shall be dimensioned with dimensions to be referenced from column lines.

C. Shop drawings will be reviewed and returned to the Contractor with one of the following categories:

1. **Reviewed:** No further submittal action is required. Submittal shall be included in the Operation and Maintenance (O & M) manual.

2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in the comments section of the Engineer's Submittal Cover Letter.

3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and shall be required to furnish product(s) named in the Specifications and/or Drawings.

4. **Furnish as Corrected:** Contractor to submit letter verifying that the required correction(s) noted on the Engineer's Submittal Cover Letter have been received and complied with by the manufacturer(s). If equipment onsite is not in compliance with the correction(s) noted, then the Contractor shall be responsible for the cost of removing and replacing the equipment.

D. Materials and equipment which are purchased or installed without submittal review and approval will be removed and replaced with specified equipment at the Contractor's expense.

E. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.

F. All approvals required by any code or enforcement authority, insurance underwriter, etc., shall be obtained prior to equipment being submitted to the Engineer.

G. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to which item.

I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc., of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 01 – General Requirements and each Specification Section.

1.11 INTERFERENCE DRAWINGS

A. Where field conditions prohibit the installation of the plumbing or fire protection system components within the available space as indicated on the Drawings, the Contractor shall prepare a sketch to the minimum one-eighth (0.125) inch scale clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the Contract Documents without incurring additional cost.

B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Accept materials onsite in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage by storing in original packaging.

C. Do not deliver items to jobsite before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.13 GENERAL ELECTRIC REQUIREMENTS

A. Provide electric motors, control panels, certain control and safety devices, and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.

B. Electrical materials and work provided shall be in accordance with Division 26.

C. The Contractor shall notify the Architect/Engineer fourteen (14) days in advance in writing before bids are due if it is necessary to adjust the horsepower of any motors or modify any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.14 ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

A. Plumbing equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.

B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall

include any transformers for equipment requiring other voltages (277 volt, 120 volt, 24 volt, etc.).

C. During the submittal process, any proposed deviations from the specified equipment in the Contract Documents shall be clearly indicated on the Plumbing submittal(s). Voltages shall match that of the specified equipment in the Contract Documents; however, if the submitted equipment ampacity, horsepower, etc., differs from the specified equipment, then the Contractor shall coordinate any changes required for the submitted equipment's electrical characteristics with the Electrical Contractor at no additional cost to the Owner.

D. Electric Motors:

1. For each piece of equipment requiring electric drive, provide a motor having the starting and running characteristics consistent with the torque and speed requirements of the driven machine.

2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of the driven equipment on the Shop Drawings.

3. Contractor shall verify electrical characteristics of each motor with the Electrical Drawings.

4. Motors which are shipped loose from equipment shall be set by the supplying Subcontractor.

5. Alignment of motors factory-coupled to equipment and motors field-coupled to equipment shall be rechecked by the millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and rechecked again after forty-eight (48) hours of operation in designed service.

6. Where possible, motors shall be factory mounted.

1.15 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.

B. The original set of as-built drawings shall be scanned and transmitted to the Architect/Engineer in both full size bond (print) and Portable Document Format (PDF).

C. As-Built drawings: Two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each of PDF and AutoCAD 2015 files on a compact disc (CD).

1. Number of Copies: Submit one (1) set of marked-up as-built prints.

2. Number of Copies: Submit copies of as-built drawings.

a. Initial Submittal:

1) Submit PDF of scanned as-built prints and one (1) set of the prints itself.

2) Submit as-built AutoCAD digital files and one (1) set of the files plotted in PDF.

3) Architect will indicate whether general scope of changes, additional information record, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF of scanned as-built prints and three (3) sets of prints itself.

2) Submit as-built AutoCAD digital files and three (3) sets of the files plotted in PDF.

3) Plot each drawing file whether changes and additional information were recorded.

D. As-built drawings should indicate the following information at a minimum:

1. Indicate all addendum changes to the Contract Documents.
2. Remove Engineer's seal, name, address, and logo from the drawings.
3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
5. Indicate all changes to construction during the construction process.
6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
10. Location and size of all plumbing piping above ceiling—including exact locations of valves.
11. Indicate exact locations of all fire protection sprinkler heads and zone valves in the system.
12. Indicate exact locations of all roof-mounted equipment, wall, roof, and floor penetrations.
13. Indicate all changes with clouding around said changes.

1.16 STARTUP SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and startup of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report shall be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the Owner's personnel shall be provided following certification of the assembly.

1.17 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades and shall furnish all information necessary to permit the work of all other trades to be installed satisfactorily and with the least possible interference or delay.

B. Piping, fixtures, and plumbing equipment shall not be installed without first coordinating the installation of it with other trades. The Contractor, at their own expense, shall relocate all piping, fixtures, and plumbing equipment installed without coordination should the plumbing elements interfere with the proper installation and mounting of electrical elements, mechanical elements, technology elements, ceilings, architectural elements, and structural elements.

C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other trades and disciplines prior to installation.

D. In areas where more than one trade is required to utilize common openings in structural beams, joists, chases, shafts, and sleeves for the passage of conduits, raceways, piping, ductwork, and other materials, the Contractor shall coordinate the positions of all piping and plumbing equipment to be furnished under this Division so that all items, including the materials and equipment of other trades and disciplines, may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this Division does not interfere with the clearances required for finished columns, pilasters, partitions, walls, or other architectural and structural elements as shown on the Contract Documents.

F. Work that is installed under this contract and interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract Documents.

G. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and architectural finish conditions affecting all their work and shall arrange such work accordingly for the complete and satisfactory operation of all systems. The Contractor shall provide all offsets, fittings, valves, devices, and accessories that may be required to meet such conditions.

1.18 WARRANTY

A. All equipment furnished and installed under this Division shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. To "make good all defects" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.

B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories.

D. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. Cast iron waste piping and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

A. Acceptable manufacturers:

1. Precision Plumbing Products
2. MIFAB
3. Acudor
4. Elmdor
5. Milcor

B. Group valves together above suspending ceilings, walls, furred spaces, etc. to minimize the number of access panels required, but with all valves freely accessible for easy maintenance and inspection. Locate all valves within 1’-0” of the access panel entry point. Minimum size requirements shall be:

1. 18” X 18” for electrical-related items
2. 24” X 24” for plumbing-related items
3. 36” X 36” for mechanical-related items

C. Furnish access panels of proper size to service concealed valves, cleanouts, etc. as required. Panels shall be of the proper type for the material in which they occur and are to be furnished by the Contractor but installed by the trade for the material in which the access panel is installed.

D. Panels shall have flush doors with sixteen (16) gauge steel door; sixteen (16) gauge frame; metal wings for keying into construction; concealed hinges; screwdriver-operated stainless steel cam lock; shop-coated with one (1) coat of zinc chromate primer.

E. Access panels shall not be installed in gypsum ceilings in public spaces.

F. Valves above removable ceilings shall have tile clips by the Contractor for identification.

2.3 INSULATION

A. The following system(s) shall be insulated:

1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
2. All domestic hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
3. All horizontal storm drainage (primary) and overflow drainage (secondary) piping as well as roof drain bodies.
4. All domestic water piping exposed to areas subject to freezing. Refer to Section 22 05 00, Subsection 2.4 “HEAT CABLE FOR FREEZE PROTECTION OF PIPING” for additional requirements and information.

B. Domestic water, storm drainage, and waste drainage piping shall be insulated with four (4) lbs. density sectional fiberglass insulation. Insulation thermal conductivity k-value shall not exceed 0.24 and insulation shall have white “all service jacket” with vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with “all service jacket” three (3) inch wide tape. Insulation shall be used for exposed piping.

C. Acceptable manufacturers:

1. Johns Manville “Micro-Lok AP-T”
2. Knauf “ASJ/SSL”
3. Owens Corning “ASJ/SSL”

D. Minimum requirements for piping system insulation and insulation thickness shall be as shown in the table below:

MINIMUM PIPE INSULATION			**PIPE SIZE INSULATION THICKNESS (Ø)**				
SYSTEM	**FLUID TEMP RANGE**		**≤ 1”**	**1-1/4” – 2”**	**2-1/2” – 4”**	**5” and 6”**	**≥ 8”**
	°C	*°F*	*inch*	*inch*	*inch*	*inch*	*inch*
Domestic cold water	ambient	ambient	0.5	1.0	1.0	1.0	-
Domestic hot water and hot water return	43.0 – 71.0	110.0 – 160.0	1.0	1.5	1.5	1.5	-
Sanitary waste above grade receiving condensate or ice machine discharge	4.5 – 15.5	40.0 – 60.0	0.5	1.0	1.0	1.5	-
Primary and secondary storm drainage	ambient	ambient	-	-	1.0	1.0	1.0

E. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping with fiberglass insulation and with “all service jacket” protection. For exposed locations, provide one (1) inch thick rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow fitting and including all wye fittings, all the way to the change in direction at the vertical drop to below grade.

F. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping, including the roof drain bodies, with blanket-type glass fiber bonded thermosetting resin, white vinyl vapor retarding surface, and two (2) inch wide stapling/taping tab. Insulation shall be used in concealed spaces.

G. Insulate all horizontal sanitary waste piping receiving air-conditioning condensate or ice machine discharge with minimum one (1) to one and one-half (1.5) inch fiberglass insulation with jacket. Begin from the floor drain, including the p-trap, and insulate all the way to the change in direction at the vertical drop to below grade.

H. At natatoriums, including the pool equipment rooms, insulate all exposed plumbing piping with a complete aluminum jacketing system. Provide color-coded, printed pipe identification label ten (10) feet on center indicating pipe system type (e.g., storm drainage, domestic water, gas, etc.).

I. Aluminum jacketing:

1. Jacket for piping shall be 0.016 inches thick, type 3105 aluminum with factory-applied one (1) mil polykraft moisture barrier.

2. Covers for fittings shall be 0.024 inches thick, type 1100 aluminum to match pipe covering.

3. Aluminum jacketing shall be provided for all exposed piping.

4. Acceptable manufacturers:

a. ITW Insulation Systems Pabco/Childers

b. RPR Products

2.4 FLASHING

A. Vent pipes passing through roof shall be flashed watertight.

B. Roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.

C. All vent piping shall be offset above ceilings or in attic spaces as required to penetrate roofs on the least-visible side(s) of the building.

2.5 FLOOR, WALL, AND CEILING PLATES

A. Furnish and install heavy gauge, chromium-plated, steel wall and ceiling plates on all exposed pipes in finished areas where piping passes through walls, ceilings, etc.

B. Plates shall be of the type that will remain permanently in position and, where pipes are insulated, they shall be of the size necessary to cover insulated piping.

2.6 DRAIN PAN

A. Acceptable manufacturers:

1. DiversiTech

2. Killarney Metals

3. Riverside Sheet Metal

B. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan under all above grade plumbing piping in the electrical rooms, MDF rooms, and IDF rooms.

C. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan for water heaters.

D. Drain pan shall have at least two (2) inches in depth and shall extend at least six (6) inches beyond the plumbing pipe or equipment.

E. Drain pan shall be installed at least six (6) feet above electrical panels and electrical gear for accessibility and maintenance clearances and shall be installed within six (6) inches below the plumbing pipe or equipment.

F. Provide steel strut channels and hangers for drain pan support.

2.7 TRACER WIRE

A. All trace wire and trace wire components shall be domestically manufactured in the United States of America.

B. All trace wire shall have HDPE insulation intended for direct bury and color-coded per APWA standards for the specific utility being marked.

C. All trace wire shall be provided for underground, non-metallic system mains four (4) inches and larger.

1. Trace wire shall be installed in the trench on top of the underground, non-metallic piping and then attached to a metal pipe above slab at the end of the run. The wire under Division 22 scope shall extend a maximum of five (5) feet outside the building exterior to an access point.

a. Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.

D. Acceptable manufacturers:

1. Copperhead Industries

E. Trace wire (copper-clad steel):

1. Open trench installation: direct burial 12AWG, solid steel core, soft drawn tracer wire with 250 lbs. average tensile break load, thirty (30) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 “TRACER WIRE EXECUTION” for additional requirements and information. Provide Copperhead Industries “1230-SF” or an equal, accepted manufacturer.

2. Directional bore or jacketed installation: direct burial 12AWG, solid steel core, hard drawn, extra high strength, horizontal directional drill tracer wire with 1,150 lbs. average tensile break load, forty-five (45) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 “TRACER WIRE EXECUTION” for additional requirements and information. Provide Copperhead Industries “1245-HS” or an equal, accepted manufacturer.

F. Connectors (copper-clad steel):

1. Splices along the continuous run of trace wire for repair of a wire break or replacement of a filed segment of wire shall use 3M “Direct Bury Splice Kits” or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting two or more wires,

effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.

2. Branch connections for laterals, turnouts, services, and appurtenances shall use King Innovation “DryConn” Waterproof Direct-Bury Lug Connectors (Aqua) or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting one or two wires to the main trace wire without cutting the main trace wire, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.

    a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the resulting tone continues for that part of the associated segment of the underground system.

3. Non-locking, friction fit, twist-on, and taped connectors shall not be acceptable. Twisting of copper wiring shall not be acceptable.

G. Termination and access (copper-clad steel):

1. Termination and access point shall be located a maximum of five (5) feet outside the building exterior. Provide Copperhead Industries “SnakePit” access point or equivalent product by alternative manufacturer that is compatible with the complete tracer wire system.

2. Terminal box shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.

3. Terminal box shall consist of tubular housing, terminal board, and removable round lid.

4. Minimum dimensions shall be five and one-half (5.5) inches diameter and eight (8) inches high. Base shall be sized to fit four (4) inch PVC Schedule 40 pipe.

5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of the construction shall be impervious to chemicals typically used for snow and ice removal as well as pavement and hardscape maintenance.

6. Housing and lid shall be designed for easy access and maintenance:

    a. Turf and landscape areas:

        1) Light-duty housing with plastic lid

    b. Hardscape areas:

        1) Heavy-duty housing with cast iron or ductile iron lid

    c. Roadway, driveway, and parking lot applications shall not be acceptable.

7. Terminal board shall have nickel-plated brass terminals. Terminal quantity for necessary and complete installation of the system shall be provided as required with a minimum of four (4) spare terminals provided.

H. Grounding (copper-clad steel):

1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of twenty (20) feet of 14AWG, red, HDPE insulated, copper-clad steel wire connected to the anode (minimum 0.5 lbs.) that is specifically manufactured for such applications and shall be buried at the same elevation as the utility.

2. Drive-in magnesium anode shall be Copperhead Industries “ANO-1005” (1.5 lbs.) or an equal, accepted manufacturer.

2.8 PIPING SYSTEMS IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied to the piping systems below and as applicable to the scope of work installed under this Division:

1. Condensate
2. Domestic water (cold, hot, hot return)
3. Gas
4. Heat trace
5. Non-potable
6. Sanitary (vent, waste)
7. Storm drainage (primary, secondary)

B. Piping identification shall be applied to all piping systems in areas of exposed construction and in areas with accessible ceilings as well as in the following locations:

1. Both sides of each wall, floor, and ceiling penetration
2. Connections to equipment
3. Adjacent to valves and flanges
4. Adjacent to piping obstructed from view
5. Heat trace pipe runs at no more than ten (10) foot intervals or as required by the local code
6. Straight pipe runs at no more than twenty-five (25) foot intervals

C. Adhesive type labels shall not be acceptable, provide only “snap-around” or “snap-on” type labels.

D. The letter size, background color, and placement of markers shall conform to the requirements of ANSI/ASME A13.1 as well as all OSHA requirements. Identify all interior exposed piping and all piping in chases or plenums with a plastic “snap-around” or “snap-on” label indicating pipe system type and direction of flow arrow. Contractor shall clean piping prior to plastic marker installation. Provide consistent manufacturer for plastic markers of each system such that marker background colors, arrows, and system description are visually identical. Each system shall be clearly identified with a minimum

letter size of two and one-quarter (2.25) inches for pipe sizes up to four (4) inches and a minimum letter size of four (4) inches for pipe sizes larger than four (4) inches.

E. Acceptable manufacturers:

1. Seton Nameplate Corporation

2. Brady Corporation

F. Each valve in the Division 21 and Division 22 systems shall be tagged with an individual number stamped onto the valve's tag. Provide identification tags on all emergency fixtures and equipment shut-off valves.

G. Valve tags shall be brass or plastic laminate, a minimum diameter of one and one-half (1.5) inches, and shall have a brass chain with hook for securing the valve tag to the valve.

H. Valve tags shall include "P" or "FP" lettering designation to indicate the appropriate plumbing or fire protection system, respectively. Valve tag numbering shall be consecutive for each service of the plumbing or fire protection systems.

I. Provide a printed, compiled list or schematic drawing for each system indicating the tagged locations as well as a detailed description of the system or equipment being served.

J. Provide one (1) copy of each list or drawing that shall be framed and mounted at the location designated by the Building Engineer. Provide an additional copy of each list which shall be included in the O & M manual.

2.9 EQUIPMENT LABELING

A. All equipment shall be labeled; this shall include all pumps, water heaters, storage tanks, compressors, water treatment systems, utility controllers, and other similar equipment.

B. Equipment labeling shall be completed with the following items, unless noted or specified otherwise:

1. Submit schedule of equipment to be included and their designations.

2. Provide nameplates with one-half (0.5) inch high letters and fastened with epoxy or screws.

PART 3 – EXECUTION

3.1 OWNER INSTRUCTION – GENERAL

A. Provide on-site Owner training for all new equipment by factory trained specialists.

B. Use O & M manuals and actual equipment installed as the basis for instruction.

C. At conclusion of on-site training program, the Contractor shall have Owner personnel sign written certification that they have completed training and understand equipment operation. Include copy of training certificates in final O & M manual.

D. No retainage shall be released until the Owner has received all O & M manuals and as-built drawings as well as performed a first O & M walk.

E. Refer to individual equipment specifications for additional training requirements.

3.2 INSTRUCTION OF OWNER PERSONNEL

A. Prior to final inspection, the Contractor shall conduct an on-site training program to instruct the Owner's operating personnel of the operation and maintenance for the installed plumbing systems.

1. Provide the training during the Owner's regular working hours.

2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems with the project.

B. Time to be allocated for on-site training program:

1. Minimum of eight (8) hours dedicated instructor time

2. Minimum of four (4) hours per day for two (2) days

C. Before proceeding with the on-site training program, the Contractor shall submit the program syllabus, proposed times and dates, and other pertinent information for review and approval by means of:

1. One (1) copy to the Owner

2. One (1) copy to the Architect

3. One (1) copy to the Engineer

D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.

E. Use the O & M manuals as the basis of instruction. Review contents of manual in detail with personal to explain all aspects of operation and maintenance.

F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.

G. Demonstrate equipment functions both individually and as part of the total, integrated system.

H. Prepare and insert additional data into the O & M manual when the need for additional data becomes apparent during instruction and training.

I. Submit a report within one (1) week after completion of the on-site training program that demonstrations and instructions have been satisfactorily completed. Provide time, date, and hours devoted to each demonstration and instruction with a list of personnel in attendance.

J. At the conclusion of the on-site training program, the Contractor shall have an Owner-designated individual sign a certificate to certify that they have a proper and thorough understanding of the demonstrated and instructed systems. By signing the certificate, the individual agrees that all demonstrations and instructions have been satisfactorily completed regarding the scope and content of the O & M manuals used in the on-site training program.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each O & M manual.

3.3 GENERAL REQUIREMENTS

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections required for a complete and satisfactory startup.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed in such a manner and sequence as to avoid damage of components and as required by jobsite progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical, mechanical, technology, and architectural work. Equipment, accessories, and similar items requiring normal servicing or maintenance shall be easily accessible.

C. The Engineer reserves the right to direct the removal of any item which, in their opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing, and freezing with manufacturer supplied or recommended shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples, caps, plugs, and test plugs until final connection(s) to the system is made.

C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with protective covers at the following instances:

1. Floor sink opening: Protect and cover with heavy-duty plywood or heavy-duty plastic cover by SmartGuard.

2. Floor drain opening: Protect and cover with heavy-duty plastic cover by SmartGuard.

3. Cleanout opening: Protect and cover with heavy-duty plastic cover by SmartGuard.

4. Pipe opening: Protect and cover with heavy-duty plastic cover by SmartGuard.

5. Fixture opening(s): Protect and cover with plastic sheet cover until final punch list.

D. Handle and store materials in accordance with the manufacturer and supplier recommendations and in a manner preventing damage to the materials during storage and handling. Replace all damaged materials.

E. Equipment and materials shall not be installed until the environmental conditions of the jobsite are suitable to satisfactorily protect the equipment and materials. Equipment and materials damaged or subjected to adversarial environmental conditions shall not be acceptable and shall be removed from the jobsite and replaced accordingly.

F. Use of duct tape or other similar protection methods shall not be acceptable.

3.5 EXCAVATION, TRENCHING, AND BACKFILLING

A. The Contractor shall perform all excavation required to install the work specified herein and as indicated on the Drawings. During excavation, material for backfilling shall be piled back

from the trench banks to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for the backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and excavated areas. Any water accumulation therein shall be removed via pumping. All excavation shall be made by open cut. Tunneling and boring shall not be acceptable except underneath pavement.

B. The bottom of the trenches shall be graded to provide uniform bearing and supports for piping, fittings, etc. on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth and tamped in twelve (12) inch layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with the specified material for a minimum of twelve (12) inches below invert elevation of the equipment or installation.

C. The Contractor shall coordinate and provide pipe supports as required per structural Drawings for any void form system such as piping under the slab, piping exiting the building, special requirements on the backfill, etc. and as such all piping shall be supported by an approved, suspended system.

1. System structure:

   a. Provide a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.

   b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system then remains independent from the securing hangers.

   c. The open space of the system beneath the structural slab is designed to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.

2. System components:

   a. The system shall maintain its structural integrity in all humid environment conditions and shall have waterproof components appropriate for its intended performance. All system components, excluding all thread rods, nuts, and washers, shall be furnished by the system manufacturer.

   b. All vertical all thread rods shall have a component secured toward the top end and permanently affixed into the concrete slab to maintain the specified elevations.

   c. System shall be installed per the manufacturer’s requirements and recommendations. The Contractor shall coordinate the system installation with the structural Drawings and the manufacturer guidelines as required.

D. The trenches shall be backfilled with cement-stabilized sand materials approved for backfill purposes, deposited in six (6) inch layers, and tamped until the crown of the pipe is covered by a minimum of six (6) inches of material.

1. Provide a sand-cement mixture producing a minimum unconfined compressive strength of one hundred (100) PSI in forty-eight (48) hours.

a. Design shall be based on strength specimens molded in accordance with ASTM D588 at a moisture content within three (3) percent of optimum and within four (4) hours of batching.

b. Determine minimum cement content from product data and statistical history. Provide no less than one and one-tenth (1.1) sacks of cement per ton of dry sand.

2. Cement: Portland cement Type I conforming to ASTM C150

3. Sand: Clean, durable sand meeting the grading requirements for fine aggregates of ASTM C33 and the following requirements:

a. Classified as SW, SP, SW-SM, SP-SM, or SM by the Unified Soil Classification System of ASTM D2487.

b. Deleterious materials:

1) Organic impurities colored no darker than the standard color and conforming to the requirements ASTM C40.

2) Lightweight pieces less than five (5) percent and conforming to the requirements of ASTM C123.

3) Clay lumps less than one-half (0.5) percent and conforming to the requirements of ASTM C142.

c. Plasticity index of four (4) or less when tested in accordance with the requirements of ASTM D4318.

E. Provide a layer of sand at least six (6) inches deep under all plastic pipe installed in soil. Bell end of pipe shall be excavated to ensure that the pipe rests for its entire length upon a solid trench bottom.

F. The backfill under and beside the pipe shall be compacted for pipe support. The backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer’s installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirements. The backfill process shall be carried out simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to ninety-five (95) percent of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water shall not be acceptable. Reopen any trenches not meeting compaction requirements or, where settlement occurs, the Contractor shall refill, compact, and restore the surface to the grade and compaction indicated as well as mounded over and smoothed off. A metallic-lined, underground warning tape shall be provided twelve (12) inches below finished grade. The warning tape shall be identifiable as to the type of line per OSHA and ANSI standard nomenclature and color.

G. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.6 TRACER WIRE EXECUTION

A. Trace wires shall be installed adjacent to nonmetallic underground water, gas, and main sewage lines underneath the building pad and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping systems as follows:

1. Natural gas: yellow
2. Sanitary sewer: green
3. Storm sewer: green
4. Water (potable): blue
5. Water (non-potable): purple

B. Trace wires shall be installed adjacent to nonmetallic underground gas lines at site and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping system as follows:

1. Natural gas: yellow

C. Install trace wire as required by this Section and in accordance with the local codes:

1. Trace wire shall be installed in the same trench as its associated piping and shall be installed inside bored holes and casing with pipe during pipe installation. Trace wire shall be secured to the pipe as required to ensure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved, watertight connector to provide electrical continuity and shall be accessible at all trace wire access points.
2. Prior to backfill, install trace wire on top of pipe and secure in place with ties or hitches at a maximum of ten (10) foot intervals and in accordance with the local jurisdiction’s water utility requirements. Run trace wire continuously along the pipe and terminate at access points. Where buried splices occur, use an approved electrical splicing kit only. Provide no less than twenty-four (24) inches of coiled wire at access points for attachment to pipe-locating equipment. Each installed pipe run shall be capable of being located using the trace wire system. Protect wire insulation from damage during installation and backfill. Wire insulation that is broken, cut, or damaged shall be replaced.
3. At the point of connection between existing, conductive pipes, the trace wire shall not be connected to the conductive pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved, waterproof connection to a grounding anode and buried at the same depth as the trace wire. All such connections points shall be grounded.
4. Where existing trace wire is encountered on an existing pipe run that is being extended or tied into, the new and existing trace wire shall be connected using approved splice connectors, shall be properly grounded at the splice location(s) as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.

5. Trace wire shall be laid flat and securely affixed to the pipe at the three (3) o'clock position. The wire shall be protected from damage during execution of the work. No breaks or cuts in the trace wire or trace wire insulation shall be permitted. At service saddles, placing the trace wire between the saddle and the main shall not be acceptable.

6. At all main end caps, a minimum of six (6) feet of trace wire shall be extended beyond the end of the pipe, coiled, and secured to the cap for future connections. The end of the trace wire shall be spliced to the wire of a six (6) lbs. zinc anode and buried at the same elevation as the pipe main.

7. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valve boxes near pipe intersections, e.g., tees and crosses, may require more than one access point assembly in each concrete valve box collar.

8. At the point of connection between ductile iron water mains and any dissimilar material, the trace wire shall be properly connected to the iron pipe with a "Cadweld" or approved equivalent. Trace wire welds shall be completely sealed with the use of an approved, mastic-type sealer specifically manufactured for installation at below grade. Mastic shall be applied in a thick coat at a minimum of one-quarter (0.25) inch in thickness and shall be protected from contamination by the backfill material with the use of a plastic membrane.

9. Trace wire systems shall be installed as a single continuous wire except where approved connectors are used. Looping or coiling of the wire shall not be acceptable.

10. Any damage occurring during the installation of the trace wire shall be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping or spray coating shall not be acceptable.

11. Open trench installation:

    a. Trace wire shall be placed a minimum of eight (8) inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems, trace wire shall be laid directly upon pipe and attached at a maximum of ten (10) foot intervals with non-conductive tape. Additional attachment(s) shall be provided at offsets and fittings in the piping system. Trace wire shall be placed carefully, and great care shall be exercised during the backfill process to maintain physical integrity and position relative to piping.

    b. Splices in trace wire shall be kept to an absolute minimum. When splices are necessary, they shall be made with approved trace wire connectors as specified. Other splicing methods shall not be acceptable.

12. Directional bore or jacketed installation:

    a. Two (2) trace wires shall be provided with one (1) wire as backup.

    b. Trace wires shall be pulled through bore hole(s) in conjunction with utility piping. Wires shall be located on opposite sides of utility piping.

    c. Trace wire splices shall not be acceptable in drilled sections.

13. Trace wires shall be interconnected at intersections of mainlines and branches utilizing a single three-way connector at each point of connection.

14. A terminal box shall be provided at each building utility service entrance and shall be located above piping within five (5) feet of the point of entry into the building.

15. Terminal boxes shall not be located more than one thousand (1,000) linear feet of developed pipe length apart.

16. Terminal boxes shall not be installed at streets, drives, parking lots, or other areas subject to vehicular traffic.

17. Terminal boxes shall not be installed at areas where access to the box is impeded.

18. Terminal boxes shall be installed flush with finished grade and centered in grade-level concrete pads. Concrete pad shall be 18” X 18” minimum and shall be six (6) inches thick.

19. PVC pipe risers shall be firmly attached to the bottom of the terminal box housing and extended downward to an elevation approximately twelve (12) inches above piping. Riser shall serve as a vertical conduit for guiding trace wires into the bottom of the terminal box.

20. Care shall be taken to extend trace wire from utility pipe to the terminal box in an orderly and workmanlike manner as backfill is placed.

21. The end of each trace wire shall be properly landed on a dedicated terminal within the terminal box(es) and securely tightened. Twelve (12) to eighteen (18) inches of excess length shall be provided for each wire within a box. Each terminal shall be clearly identified with permanent labeling. Where trace wires for multiple utilities are terminated, care shall be taken to ensure accuracy of identification at both ends.

D. Testing:

1. All new trace wire installations shall be located using typical low frequency (512 hertz) line tracing equipment and witnessed by the Contractor, Engineer, and Owner’s designated representative prior to acceptance of ownership.

2. The verification shall be performed upon completion of rough grading and again prior to final acceptance of ownership.

3. Final testing of each trace wire shall be performed after the backfill process is complete, terminal boxes have been permanently installed, and wires are terminated. Testing shall be witnessed by the Architect, Engineer, and Owner’s designated representative. It may be advisable for the Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing shall not be acceptable.

E. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.7 CONCRETE WORK

A. Construct curbs, pads, vaults, and similar supports for equipment where required.

B. First floor and equipment yard: provide a minimum of six (6) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment.

C. Second floor and above: provide a minimum of four (4) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment. Dowel pads to the structural slab.

D. Perform all concrete work in accordance with applicable portions of the concrete sections of the code. Minimum compressive strength of concrete shall be the same as specified for slabs on grade.

3.8 CLEANING OF PIPING SYSTEMS

A. Provide cleaning of installed piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to completely clean, purge, and circulate the system as required.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, fixtures, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements:

1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line-size blow down ball valve and pipe to nearest drain. Blow down, remove, and clean strainers as frequently as necessary.

2. Phase I: Initial flushing of systems. Remove loose dirt, mill scale, weld beads, rust, and other deleterious substances without damage to the system components. Open valves, drains, vents, and strainers at all system levels during flushing procedures. Flush until potable water is clear and particles larger than five (5) microns are removed. Connect dead-end supply and return headers, even if not shown on the Drawings, and provide terminal drains in bottom of pipe end caps or blind flanges. Dispose of water in an approved manner.

3. Phase II: Cleaning of piping systems. Remove, without chemical or mechanical damage to any system component, adherent dirt, organic soil, hydrocarbons, soldering flux, mill varnish, piping compounds, rust, and other deleterious substances not removed by initial flushing. Flush system and replace with clean, potable water.

4. Phase III: Final flushing and rinsing of systems. Flush and rinse until potable water is clear and particles larger than five (5) microns) are removed. Operate valves to dislodge any debris in the valve body. Dispose of water in an approved manner.

5. Submit status reports upon completion of each phase of work on each system.

3.9 TESTING OF PIPING SYSTEMS

A. General:

1. Prior to insulation and concealment, all piping systems shall be subjected to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.

2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's designated representative with a minimum of forty-eight (48) hours' notice given to the parties involved.

3. All equipment, material, labor, and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.

4. All connected fixtures, equipment, accessories, etc. shall be isolated from the piping systems prior to testing.

B. Sanitary piping system:

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section enduring testing. All sections shall be tested with a minimum of ten (10) feet of head. In testing successive sections, at least the upper ten (10) feet of the next section shall be tested so that no piping joint in the building shall undergo a test consisting of less than ten (10) feet of head. The water shall be successfully kept in the system for at least thirty (30) minutes before inspection begins. The system shall then be made tight at all points.

2. Any point(s) of the drainage systems to be tested with air instead of water shall be performed by attaching a compressed air testing apparatus to any suitable opening and, after closing tight all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of five (5) PSI. This pressure shall be held without the introduction of additional air for a period of at least thirty (30) minutes.

3. Exterior connections shall be tested as part of the interior systems.

C. Interior water piping system:

1. Upon completion of the entire water supply system or a section of it as required, the system shall be tested prior to connection of fixtures, equipment, accessories, etc. and proved tight under a water or air pressure test of at least one hundred and fifty (150) PSI. Pressure shall hold for a period of one (1) hour without introducing additional water or air. Water used for testing shall be from a potable supply source. Defective joints or piping shall be replaced as required and all piping shall be retested as required.

D. Defective work:

1. If inspection or tests show defects, such defective work or material shall be replaced, and the inspections and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes shall not be acceptable.

E. Additional tests:

1. Provide all additional tests such as smoke, pressure, etc. as required by the regulations or as directed by jurisdictional authorities making the inspection.

2. Provide for any repeated test as directed by the Owner's designated representative to ensure all systems are tight as required.

3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.10 OPERATING TESTS

A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and performance through the range of its operations. Tests shall be made in the presence of the Architect and Engineer. Provide adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under their respective Specification Sections.

B. Submit three (3) copies of all certifications and test reports in a timely manner ahead of work completion to allow adequate time for remedial action as required to correct deficiencies discovered in the equipment and plumbing systems.

3.11 DISINFECTION OF INTERIOR AND EXTERIOR WATER SYSTEMS

A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.

B. Whenever the authorities having jurisdiction do not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than fifty (50) parts per million of chlorine. The chlorinating solution shall be liquid chlorine of sodium hydrochloride solution and shall be introduced and drawn to all points in the system. The disinfecting solution shall be allowed to remain in the system for a period of eight (8) hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be thoroughly flushed from the system with clear, potable water until the residual chlorine content is no more than two-tenths (0.2) parts per million.

C. This work shall be supervised or performed by an approved chemical testing laboratory and the results shall be sent to the Engineer or their representative for verification.

3.12 OPERATION AND MAINTENANCE MANUALS

A. Form of manuals:

1. Prepare data in the form of an instructional manual for use by the Owner’s personnel.

2. Format:

   a. Size: Letter size (8.5” X 11”).

   b. Text: Manufacturer’s printed data or neatly typewritten equivalent.

3. Drawings:

   a. Provide reinforced punched binder tab and bind in text.

   b. Fold larger drawings to be of at least the same format size as specified hereinbefore.

4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.

5. Cover:

   a. Identify each volume with the printed title, “Operating & Maintenance Instructions” and include the following elements:

1) Title of project

2) Identity of separate structures or facilities as applicable

3) Identity of general subject matter covered in that specific volume

6. Bind as specified.

B. Content of manuals:

1. Provide a neatly typewritten table of contents for each volume, arranged in a systematic order as outlined in the Specifications, and include the following elements:

a. The Contractor name, name of responsible principal, address, and telephone number

b. Each product required to be included in the table of contents and indexed appropriately to the content of the volume

c. Each product's associated address, telephone number, and name of:

1) The Subcontractor or installer

2) Maintenance Contractor, if applicable

3) Identify areas of responsibilities for each party

4) Local source of part supplies and part replacement

d. Identify each product by the product name and other identifying symbols as set forth in the Contract Documents.

2. Product data:

a. Include sheets pertinent to the specific product.

b. Annotate each sheet to:

1) Identify specific product or part installed

2) Identify data applicable to installation

3) Delete references to inapplicable information

a) All options not supplied with equipment shall be marked out or indicated in some manner.

3. Drawings:

a. Supplement product data with drawings as necessary to illustrate:

1) Relations of component parts of equipment and systems

2) Controls and flow diagrams

b. Coordinate drawings with information in the Project Record Documents to assure correct illustration of completed installation.

c. Do not use the Project Record Documents as maintenance drawings.

4. Written text, as required to supplement product data for a specific installation, shall include:
    a. Separate headings for different procedures and organized in a consistent format
    b. Logical sequence of instructions for each procedure
5. Copy each warranty, bond, and service contract issued.
    a. Provide an information sheet for the Owner's personal indicating:
        1) Proper procedures in the event of failure
        2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings, and product data as specified.

C. Sections for equipment and systems:
1. Content for each unit of equipment and system as applicable:
    a. Description of unit and component parts:
        1) Function, normal operating characteristics, and limiting conditions
        2) Performance curves, engineering data, and tests
        3) Complete nomenclature and commercial number of replaceable parts
    b. Operating procedures:
        1) Startup, break-in, routine, and normal operating instructions
        2) Regulation, control, stopping, and emergency shutdown instructions
        3) Summer and winter operating instructions
        4) Special operating instructions
    c. Maintenance procedures:
        1) Routine operations
        2) Guide to troubleshooting
        3) Disassembly, repair, and reassembly
        4) Alignment, adjusting, and checking
        5) Routine service based on operation hours
    d. Servicing and lubrication schedule as well as a list of lubricants required.
    e. Manufacturer's printed operating and maintenance instructions.
    f. Description of sequence of operation by the controls manufacturer.

g. Installed equipment and system control diagrams by the controls manufacturer.

h. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include:

1) Predicted life of each part subject to wear

2) Items recommended to be stocked as spare parts

i. Complete equipment internal wiring diagrams.

j. Each Contractor's coordination drawings.

k. Color-coded piping diagrams of the installed equipment and systems.

l. Charts of valve tag numbers with location and function of each valve.

m. Other data as required under relevant sections of the Specifications.

2. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.

3. Additional requirements for operating and maintenance data as outlined in relevant sections of the Specifications.

4. Provide complete information for products specified in Division 22.

5. Provide certificates of compliance as specified in each related section of the Specifications.

6. Provide startup reports as specified in each related section of the Specifications.

7. Provide signed receipts for spare parts and materials.

8. Provide training report and certificates.

9. Provide backflow preventer certification test reports.

10. Provide gas piping pressure test reports.

END OF SECTION 22 05 00

SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Expansion joints
2. Pipe alignment guides
3. Pipe anchors

B. Related Sections:

1. 22 05 29 – PLUMBING HANGERS AND SUPPORTS
    a. Product and installation requirements for piping hangers and supports.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints shall adequately provide protection of the system.

B. Expansion compensation design criteria:

1. Installation temperature: fifty (50) degrees Fahrenheit
2. Domestic hot water: one hundred and forty (140) degrees Fahrenheit
3. Safety factor: thirty (30) percent

1.4 SUBMITTALS

A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.

B. Shop drawings: indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered Professional Engineer.

C. Product data:

1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
2. Expansion joints: indicate maximum temperature, pressure rating, and expansion compensation.

D. Submit calculations of the design data indicating calculation criteria and sealed by a registered Professional Engineer.

E. Submit special procedures as required by the manufacturer's installation instructions.

F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.

G. Submit welders' certificate indicating compliance with all American Welding Society (AWS) D1.1 "Structural Welding Code – Steel Endorsement Description" requirements.

H. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.

I. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.5 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 01 – General Requirements and each Specification Section.

B. Project Record Documents:

1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with ASME B31.9 "Building Services Piping" for installation of piping systems and ASME BPVC-IX "Welding, Brazing, and Fusing Qualifications" for welding materials and procedures.

1.7 QUALIFICATIONS

A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.

B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.8 WARRANTY

A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints onsite in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protections, and packaging in place until installation.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.

B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

2.2 EXPANSION JOINTS

A. Acceptable manufacturers:

1. VMC/Amber Booth
2. Triplex
3. Mason Industries
4. Uponor

B. Stainless steel bellows type:

1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
2. Maximum compression: one and three-quarters (1.75) inch
3. Maximum extension: one-quarter (0.75) inch
4. Joint: provide as specified for pipe joints
5. Size: provide as per pipe size
6. Application: steel piping three (3) inches and smaller

C. External ring controlled stainless steel bellows type:

1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
2. Maximum compression: fifteen-sixteenths (0.9375) inch
3. Maximum extension: five-sixteenths (0.3125) inch
4. Maximum offset: one-eighth (0.125) inch
5. Joint: flanged
6. Size: provide as per pipe size

7. Accessories: internal flow liner

8. Application: steel piping three (3) inches and larger

D. Double sphere flexible type:

1. Construction: multi-layered Kevlar tire cord fabric reinforced with peroxide-cured EPDM cover, liner, and fabric frictioning

2. Pressure rating of two hundred and fifteen (215) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit

3. Maximum compression: one and one-quarter (1.25) inch permissible compression for up to six (6) inch pipe size; one and one-half (1.5) inch permissible compression for eight (8) inch pipe size and up to twelve (12) inch pipe size; one and one-fifth (1.2) inch permissible compression for fourteen (14) inch pipe size.

4. Maximum elongation: three-quarters (0.75) inch permissible elongation for up to six (6) inch pipe size; one and one-half (1.5) inch permissible elongation for eight (8) inch pipe size and up to twelve (12) inch pipe size; five-eighths (0.625) inch permissible elongation for fourteen (14) inch pipe size.

5. Maximum offset: three-eighths (0.375) inch permissible offset for up to six (6) inch pipe size; seven-eighths (0.875) inch permissible offset for eight (8) inch pipe size and up to twelve (12) inch pipe size; one (1) inch permissible offset for fourteen (14) inch pipe size.

6. Maximum angular movement: fifteen (15) degrees

7. Joint: steel or ductile iron flanges

8. Size: provide as per pipe size

9. Accessories: control rods

10. Application: steel piping three (2) inches and larger

E. PEX-a pipe support:

1. For use with Uponor PEX-a pipe

2. Continuously support PEX-a piping with manufacturer approved pipe support systems and utilize fixed anchor points every:

a. Sixty-five (65) feet for domestic hot water

b. One hundred and fifty (150) feet for domestic cold water

3. Utilize manufacturer-provided stainless steel straps to secure the PEX-a pipe supports to the pipe at the intervals specified in the manufacturer’s installation instructions.

4. Refer to the Uponor “Plumbing Design Assistance Manual” (PDAM) for more information.

2.3 ACCESSORIES

A. Acceptable manufacturers:

1. VMC/Amber Booth
2. Triplex
3. Mason Industries

B. Pipe alignment guides: two-piece welded steel, bolted, with enamel paint and with spider to fit standard pipe; frame with four mounting holes; clearance for minimum of one (1) inch thick insulation; minimum of three (3) inches for travel.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine piping layout and notify the Architect and Engineer of additional anchors or expansion joints required to adequately protect the system.

B. Provide inspection services by the flexible pipe manufacturer's designated representative for final install and certify that the installation is in accordance with the manufacturer's recommendations as well as that the connectors are performing satisfactorily.

3.2 INSTALLATION

A. Install work in accordance with ASME B31.9 "Building Services Piping" and any applicable local codes.

B. Install piping to allow for expansion and contraction without stressing piping, joints, or connected equipment.

C. Flexible piping shall not be used in concealed spaces. Access panels shall be provided for concealed space installations.

D. Provide supports and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints or expansion joints where required. Refer to Section 22 05 29 – PLUMBING HANGERS AND SUPPORTS for pipe hanger installation requirements.

E. Provide grooved piping systems with a minimum of one (1) joint per inch of pipe diameter instead of flexible connectors supported by vibration isolation. Grooved piping systems need not be anchored.

F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to the isolated equipment and anchor the other end.

G. Provide expansion loops as per the pipe manufacturer's design guidelines or as indicated on the Drawings. Rigidly anchor pipe to the building structure where necessary and as required. Provide pipe guides so that movement takes place along the pipe's axis only. Rigidly anchor pipe to the building structure to prevent stress, strain, and loading transfer to connected equipment.

H. Coordinate with the installation of piping seismic braces so that they do not interfere with thermal expansion loop action or building joint loop action.

I. Install expansion compensating devices for PEX-a piping in accordance with the manufacturer's installation instructions.

END OF SECTION 22 05 16

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

A. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Unistrut Corp.
2. Erico Caddy.
3. PHP System.
4. Anvil/Anvil Strut.
5. BLINE.

B. Pipe Supports:
1. Conform to MSS SP58.
2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring.
3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
   a. Provide at all system stub-ups from below grade thru ground floor slab.
8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
12. Non-metallic pipe support: Vinyl-coated Hangers.
13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
14. Unless otherwise noted, galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

B. Provide locking nuts on all rod extensions.

C. Unless otherwise noted, galvanized steel to be used for outdoor installation.

2.3 INSERTS

A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.

C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.

D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.

E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.

G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.

H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer’s approval.

I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.

J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.

K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. Thunderline Link-Seal, Inc., or approved equal.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

A. Manufacturers:
   1. Unistrut Corp., or approved equal.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

A. Manufacturers:
   1. Dow Corning Corp. Model.
   2. 3M fire Protection Products Model.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
   1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
   2. Foam Firestopping Compounds: Multiple component foam compound.
   3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
   4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
   5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
   6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
   7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray Black As selected from manufacturer’s full range of colors.

D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer’s system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
   1. Mineral fiberboard.
   2. Mineral fiber matting.
   3. Sheet metal.

4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing or damming materials to arrest liquid material leakage.

D. Do not drill or cut structural members.

E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.

F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with MSS SP 58.

B. Supports for Gas Piping:
   1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
   2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.

C. Supports for Cast Iron Piping:
   1. Vertical Piping:
      a. Support vertical piping and tubing at base and at each floor.
      b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
      c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
   2. Horizontal Piping, Suspended:
      a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
      b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
      c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
      d. An anchor or bracing to be provided on all storm drain pipe fittings.
   3. Place hangers within 12 inches of each horizontal elbow.
   4. Use hangers with 1-1/2 inch minimum vertical adjustment.
   5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
   6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
   7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
   8. Support riser piping independently of connected horizontal piping.

D. Supports for copper tubing:
   1. The following maximum horizontal spacing and minimum rod diameters:
      a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
      b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
      c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
      d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod

2. Install supports for vertical copper tubing every 10 feet (3 m).
3. Support vertical piping and tubing at base and at each floor.

E. Supports for steel piping:
1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
2. Install supports for vertical steel piping every 15 feet (4.5 m).
3. Support vertical piping and tubing at base and at each floor.

F. Supports for stainless-steel piping:
1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
2. Install supports for vertical steel piping every 15 feet (4.5 m).
3. Support vertical piping and tubing at base and at each floor.

G. Supports for CPVC piping:
1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
3. Support vertical piping and tubing at base and at each floor.

H. Supports for PEX tubing:
1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
   b. ¾" and smaller: 72 inches when a continuous support channel is used.
   c. 1" and larger: 96 inches when a continuous support channel is used.
2. Support vertical piping and tubing at base and at each floor.
3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.

I. Supports for PVC piping:
1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
   e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
2. Install supports for vertical PVC piping every 48 inches (1200 mm).
3. Support vertical piping and tubing at base and at each floor.

J. Supports for PP piping:
1. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
   a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
   b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
   f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod
2. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
3. Support vertical piping and tubing at base and at each floor.
4. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

K. Supports for insulated piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
   e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

L. Supports for Vertical-Piping
   1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
      a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
      b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

M. Design hangers for pipe movement without disengagement of supported pipe.

N. Provide clearance in hangers and from structure and other equipment for installation of insulation.

O. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.

E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.

F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.

D. Fire Rated Surface:
   1. Seal opening at floor and wall as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
      c. Pack void with backing material.
      d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

E. Non-Rated Surfaces:
   1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
      a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
      b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
      c. Install type of sealant or caulk suitable for application.
   2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
   3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

C. 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

D. 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

E. 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

F. 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

G. 22 20 23 – GAS PIPING

1.2 SUMMARY

A. It is the intent of this Section to provide vibration isolation supports for all equipment and piping as it may be required to prevent transmission of vibration to the building structure. It shall be the Contractor's responsibility to select and install vibration isolators which shall meet the specified noise criteria standards to the extent that the noise can be controlled by the vibration isolators.

1.3 REFERENCES

A. International Code Council (ICC) "International Building Code"

1.4 PERFORMANCE REQUIREMENTS

A. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

B. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of one-half (0.5) horsepower and larger. Deflections as tabulated are minimums and it shall be the vibration isolator manufacturer's responsibility to determine the amount of spring deflection required for each isolator to achieve optimal performance in preventing transmission of objectionable vibrations and in meeting the noise criteria standards referenced herein.

C. Unless otherwise noted, equipment driven by motors one-quarter (0.25) horsepower and smaller shall be isolated by means of type "ND" elastomeric mounts or type "HD" elastomeric hangers properly sized for seven-twentieths (0.35) inch deflection.

D. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and antioxidant additives.

E. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

F. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of thirty (30) pounds per square foot. Wind loads shall be applied to all exposed surfaces of the isolated equipment to identify worst-case scenario loads.

G. All spring isolators shall be completely stable in operation and shall be designed for not less than fifty (50) percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a K_x and K_y anisotropic ratio of at least 1:1.

H. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory-certified data. Any variance or non-compliance with these Specification requirements shall be corrected by the Contractor at no additional cost to the Owner. The manufacturer may purchase other manufactured products to meet this Specification and shall guarantee outsourced products as a single point of responsibility. Outsourced products shall be identified as such in the submittal for approval.

I. The Contactor and manufacturer of the isolation devices and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.

J. Deflection information is based on maintaining rooms at the following maximum sound levels, denominated in Noise Criteria (NC) as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the American National Standards Institute (ANSI) S1.8 “Reference Values for Levels used in Acoustics and Vibrations” requirements.

RECOMMENDED NOISE CRITERION			
CATEGORY	**TYPE OF ROOM**	**NOISE CRITERION LEVEL**	**EQUIVALENT SOUND LEVEL**
		NC	*dB_A*
Offices	Conference rooms	25 – 30	35 – 40
Offices	Private	30 – 35	40 – 45
Offices	Open-plan areas	35 – 40	45 – 50
Offices	Business machines, computers	40 – 45	50 – 55
Offices	Circulation	35 – 40	45 – 50
Schools	Lecture and classrooms	25 – 30	35 – 40
Schools	Open-plan classrooms	35 – 40	45 – 50
Libraries	Libraries	35 – 40	40 – 50
Theaters	Theater	20 – 25	30 – 35
Theaters	Stage house	20 – 25	30 – 35
Theaters	Trap room	20 – 25	30 – 35
Theaters	Orchestra pit	20 – 25	30 – 35
Theaters	Rehearsal rooms	20 – 25	30 – 35
Theaters	Teaching studios	25 – 30	35 – 40
Theaters	Practice rooms	25 – 30	35 – 40
Theaters	Ensemble rooms	25 – 30	35 – 40
Theaters	Set shop	40 – 45	50 – 55

1.5 SUBMITTALS

A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.

B. Shop drawings: indicate inertia bases and locate vibration isolators with static and dynamic loads annotated on each instance. Indicate assembly, materials, thicknesses, dimensional data, layouts, and connection details. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

C. Product data:

1. Submit schedule of vibration isolator types with locations and loads on each instance. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.

D. Submit calculations of the design data indicating maximum room sound levels are not exceeded.

E. Submit special procedures as required by the manufacturer's installation instructions. Indicate installation requirements maintaining integrity of sound isolation.

F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.

G. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.

H. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 QUALITY ASSURANCE

A. Testing agency qualifications: independent agency with the experience and capability to conduct the testing indicated. Agency shall be certified as a Nationally Recognized Test Laboratory (NTRL) as defined by Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory" as well as certified by the local authorities having jurisdiction.

B. Welding qualifications: qualify procedures and personnel according to American Welding Society (AWS) D1.1/D1.1M "Structural Welding Code – Steel" requirements.

C. All plumbing systems' vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 – PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

A. All vibration isolators described in this Section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Section 22 05 48.13, Subsection 1.4 "PERFORMANCE REQUIREMENTS" and the information below.

B. Acceptable manufacturers:

1. VMC/Amber Booth
2. Mason Industries
3. Kinetics Noise Control
4. Vibration Eliminator Company

C. Type “WSW”

1. Two (2) layers of three-eighths (0.375) inch thick neoprene pad consisting of square waffle modules separated horizontally by a sixteen (16) gauge galvanized shim. Where the load bearing area of the equipment is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of three twenty-fifths (0.12) inch up to four twenty-fifths (0.16) inch.

D. Type “ND”

1. Neoprene mountings shall have minimum static deflection of seven-twentieths (0.35) inch. All metal surfaces shall be neoprene covered and have friction pads at both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment, such as small vent sets, to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized.

E. Type “SLF”

1. Spring isolators shall be free-standing and laterally stable without any housing and complete with a molded neoprene cup or one-quarter (0.25) inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed height and operating height shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than four-fifths (0.8). Springs shall have minimum additional travel to solid equal to fifty (50) percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height, and solid spring height.

F. Type “SLR”

1. Restrained spring mountings shall have an “SLF” mounting as described in Subsection 2.1.E “Type ‘SLF’” and within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and the spring to avoid interference with any spring action. Limit stops shall be out of contact during normal operation. Since housings are bolted or

welded in position under outdoor equipment, there shall be an internal isolation pad in addition to the friction pad on the bottom.

G. Type “HD”

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers.

H. Type “30N”

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element at the top and a steel spring as described in Subsection 2.1.E “Type ‘SLF’” and seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene molded bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers, nor shall the neoprene element be stacked on top of the spring. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a thirty (30) degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the thirty (30) degree arc capability.

I. Type “PC30N”

1. Hangers shall be as described in Subsection 2.1.H “Type ‘30N’” but shall be pre-compressed and locked at the rated deflection by means of a resilient seismic up stop to keep piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a hanger drawing showing the thirty (30) degree capability.

J. Type “WBI/WBD”

1. Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup as described in Subsection 2.1.E “Type ‘SLF’” and with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be present for thrust at the factory and adjusted in the field to allow for a maximum of one-quarter (0.25) inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached to the centerline of thrust and symmetrical on either side of the unit.

K. Type “SLR-MT”

1. Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable and flexible nylon (Kevlar) reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of three (3) hertz. Air springs shall be designed for a burst pressure that is a minimum of three (3) times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed.

The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and air springs to avoid interference with any air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three (3) leveling valves to maintain level within plus or minus one-eighth (0.125) inch. Air spring mounts shall be located between the supporting steel and the roof, or the grillage and dunnage as shown on the Drawings when there is no provision for direct mounting. Submittals shall include natural frequency and tests for load and damping performed by an independent lab or acoustician.

2.2 BASES

A. Type “WF”

1. Welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be “T” or “L” shaped. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to one-tenth (1/10) of the longest dimension of the base. Base depth need not exceed fourteen (14) inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

B. Type “ICS”

1. Vibration isolation manufacturer shall provide steel members welded to height savings brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent distortion and misalignment of equipment.

C. Type “RBMK”

1. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, steel formed bases, and sheet metal formed bases shall not be acceptable. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. Bases may be “T” or “L” shaped where space is a problem. Bases shall be a minimum of one-twelfth (1/12) of the longest dimension of the base but not less than six (6) inches. Base depth need not exceed twelve (12) inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include concrete reinforcement consisting of bars that are a minimum of one-half (0.5) inch and welded in place on six (6) inch centers, running both ways in a layer of one and one-half (1.5) inch above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

2.3 FLEXIBLE PIPE CONNECTIONS

A. Type “SFDEJ,” “SFEJ,” “SFDCR,” “SFU,” and “CR” (control rods):

1. Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions shall have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out.

2. Flexible cable wire shall not be acceptable.

3. Sizes one and one-half (1.5) inch through fourteen (14) inches shall have a ductile iron external ring between the two spheres.

4. Sizes sixteen (16) inches through twenty-four (24) inches may be a single sphere.

5. Sizes three-quarters (0.75) inch through two (2) inches may be a single sphere, bolted threaded flange assemblies and cable retention.

6. Minimum ratings through fourteen (14) inches shall be two hundred and fifty (250) PSI at one hundred and seventy (170) degrees Fahrenheit and two hundred and fifteen (215) PSI at two hundred and fifty (250) degrees Fahrenheit.

7. Minimum ratings for sixteen (16) inches through twenty-four (24) inches shall be one hundred and eighty (180) PSI at one hundred and seventy (170) degrees Fahrenheit and one hundred and fifty (150) PSI at two hundred and fifty (250) degrees Fahrenheit.

8. Higher published rated connectors may be used where required.

9. Safety factors shall be a minimum of three hundred (300) percent. All expansion joints shall be factory tested to one hundred and fifty (150) percent of maximum pressure for twelve (12) minutes before shipment.

10. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing though one-half (0.5) inch thick neoprene washer bushings large enough to take the thrust at one thousand (1000) PSI of surface area may be used on unanchored piping where the manufacturer determines the conditions exceed the expansion joint rating without them.

11. Submittals shall include two (2) test reports by independent consultants showing minimum reductions of twenty (20) decibels in vibration accelerations and ten (10) decibels in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

12. All expansion joints shall be installed on the equipment side of the shut-off valves.

2.4 MECHANICAL ANCHOR BOLTS

A. Drilled-in and stud-wedge type or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 “Standard Test Methods for Strength of Anchors in Concrete Elements” requirements. The stud anchors shall have an evaluation report number from the ICC-ES verifying its allowable loads.

2.5 ADHESIVE ANCHOR BOLTS

A. Drilled-in and capsule anchor system containing polyvinyl chloride or urethane methacrylate-based resin and accelerator; or an injected polymer; or a hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 “Standard Test Methods for Strength of Anchors in Concrete Elements” and ICC-ES AC308 “Post-installed Adhesive Anchors in Concrete Elements” requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the work required.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations prior to installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

A. Horizontal piping:

1. Isolate all pumped water, pumped condensate, and refrigerant piping sizes one and one-quarter (1.25) inch and larger within mechanical rooms and pipe sizes two (2) inches and larger outside mechanical rooms shall also be isolated. Outside equipment rooms, this piping shall be isolated for the greater of fifty (50) feet or one hundred (100) pipe diameters from externally isolated equipment. For the first three (3) support locations from the externally isolated equipment, provide Type “30N” hangers or Type “SLF” floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a one (1) inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping yet also permitting piping to function as a floating system. Size hangers for two hundred (200) percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

B. Riser piping:

1. Isolate all vertical pipe risers one and one-quarter (1.25) inch and larger, where specifically shown and detailed on riser diagrams, shall be fully supported by Type “SLF” mounts with precompression plates and brackets. Refer to manufacturer’s details for additional information. Steel spring deflection shall be three-quarters (0.75) inch minimum. In locations where added deflection is required due to pipe expansion and contraction, the spring deflection shall be a minimum of four (4) times the anticipated movement to prevent binding. Provide Type “SWS” wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations shall show anticipated expansion and contraction at each support point, initial and final loads on the build structure, and spring deflection changes. Submittal data shall include

certification that the piping system has been examined for excessive stresses and that none exist in the proposed design.

3.3 INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points as well as with requirements for concrete reinforcement and formwork as specified in Division 03.

B. Installation of vibration isolators shall not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Locate isolation hangers as near to the overhead support structure as possible.

D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below the base is provided when supported equipment has been installed and loaded for operation.

F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and ensure that units are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices, if any, intended for temporary protection against overloading during installation or shipment.

H. Install cables so they do not bend across edges of adjacent equipment or building structure.

I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

J. Install bushing assemblies for anchor bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to walls.

K. If specific attachment to structure is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

L. Drilled-in anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical conduit, telecommunications conduit, and gas lines.

2. Drilling holes in concrete or masonry prior to concrete, mortar, or grout achieving full design strength shall not be acceptable.

3. At wedge anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with the sleeve fully engaged in the structural element to which the anchor is to be fastened.

4. At adhesive anchors, clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes beginning at the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Engage a qualified testing agency to perform tests and inspections. Coordinate with the Owner, through the Architect, for additional requirements prior to engaging the test.

B. Perform tests and inspections as required and as indicated below:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to the authorities having jurisdiction.

2. Schedule test with the Owner, through the Architect, prior to connecting anchorage devices to restrained components (unless post-connection testing has been approved) and with at least seven (7) days of advance notice.

3. Obtain the Architect's approval prior to transmitting test loads to structure. Provide temporary load-spreading members.

4. Test a minimum of four (4) installed anchors and fasteners of each type and size as selected by the Architect. Provide additional testing of more anchors if instructed by the Owner or Architect.

5. Test to ninety (90) percent of the rated proof load of device.

6. Measure isolator restraint clearance and isolator deflection.

7. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops to they are out of contact during normal operation.

END OF SECTION 22 05 48.13

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

A. Provide a complete domestic water piping system.

B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.

C. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
   4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Contractor shall ensure the installer has demonstrated experience on projects of similar size and complexity and has been trained by GF Building Flow Solutions (Uponor) or an Uponor-approved trainer.
   1. If PEX-a or Corzan® CPVC is used as an approved alternate for applications where metallic piping is the basis of design the manufacturer shall submit shop drawings clearly indicating that the design has been analyzed and modified, as required, to maintain required pressure and flow. Any design resulting in reduced system pressure as a result of improper PEX-a or Corzan® CPVC sizing or design shall not be permitted.

B. Ensure materials in contact with the Corzan® CPVC piping system are compatible with Corzan® CPVC compounds per the Lubrizol “FBC System Compatibility Program” found at www.lubrizol.com/CPVC/FBC-System-Compatible-Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.8 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

1.9 EXTRA MATERIALS

A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

A. In-Building Riser: At incoming below grade domestic water service entry for pipe sizes 4” and larger, provide a 90-degree jointless ASTM A312 304 stainless steel in-building riser by Ames Fire & Waterworks Series IBR. Lead-free, NSF approved for potable water supply, UL Listed, FM Approved, NFPA 24, AWWA C900 inlet/DIP, AWWA C606 outlet. Provide concrete thrust block at 90-degree change of direction. Provide custom length as required where standard 6’-0” length does not extend past building perimeter wall.

B. Copper Tubing: ASTM B88, Type K.
   1. Fittings: ASME B16.22 wrought copper and bronze.
   2. Joints: AWS A5.8, BCuP silver braze.

2.3 WATER PIPING, ABOVE GRADE

A. Copper Tubing 6” and smaller: ASTM B88, Type L hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints:

a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
c. Appurtenances for Grooved-End Copper Tubing:
1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
a) Victaulic
2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
3) Mechanical Couplings for Grooved-End Copper Tubing:
a) Copper-tube dimensions and design similar to AWWA C606.
b) Ferrous housing sections.
c) EPDM-rubber gaskets suitable for hot and cold water.
d) Bolts and nuts.
e) Minimum Pressure Rating: 300 psig.

3. At the Contractor's option:
a. Viega ProPress Copper and Cast Copper Alloy Press-Connect Fittings:
1) Approved for use with copper tubing conforming to ASTM B88 or B75. When pressing onto B88 copper tube, types K, L, and M may be used. Tempers O60 and O50, known as "soft copper", are limited to nominal sizes 1/2" to 1-1/4". Temper H58, known as "hard copper", may be used with nominal sizes 1/2" to 4".
2) Shall conform to ASME B16.51, ASTM B1029 & F3226, ICC AC156, IAPMO PS-117, NSF 61, and NSF 372.
3) Copper alloy fittings:
a) Shall be zero lead silicon bronze alloy C87710 (cast) or C88700 (machined).
b) Shall not be bismuth bronze or yellow brass.
4) Peroxidically cured EPDM elastomeric sealing element rated to 300 psi with a temperature range of 0-250 degrees (F). Sealing element shall be uniform in size/thickness and shall be free from manufactured deformities or indentations.
5) 420 stainless steel grip & PBT separator rings for 2-1/2" to 4" sizes.
6) Press Connect fitting shall have the Viega Smart Connect feature integral to the fitting body to detect unpressed fittings during the testing process.
7) Color-coded markings on exterior of fitting for readily identifying/inspecting sealing element type.
8) Single source manufacturer. Technology and installation instructions vary between manufacturers.
9) Approved manufacturer: Viega LLC (no exceptions).
a) Warranty: 50 years from the date of installation.

2.4 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size two (2) inches and Smaller:
1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered or press-connected joints.

B. Pipe Size 2-1/2 inches and Larger:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets or press-connected joints.

2.5 GALVANIC PROTECTION

A. Dissimilar piping material connections shall not be made without an approved dielectric union.

B. Dielectric Connections:
1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.
3. 1/2” to 4” Viega ProPress zero lead press-connect unions and flanges.

2.6 VALVES

A. General
1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.

B. Ball Valves:
1. Manufacturers:
   a. NIBCO INC.
2. Two (3) inches and Smaller: Nibco S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
4. Ball valves installed outdoors or in-ground shall have stainless steel handle.
5. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
6. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

C. Shut-off Valves:
1. Manufacturers:
   a. NIBCO INC.
2. Line Shut-Off Valves 4” and larger where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-

rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS

3. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.

D. Swing Check Valves:
1. Manufacturers:
a. NIBCO INC.
2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.

E. Balancing Valves (Hot Water Recirculation)
1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
2. Balancing valves shall be IMI Flow Design model UA Zero series (0.5 to 1.5 GPM venturi range) or approved equal by CircuitSolver, or Bell and Gossett CircuitSetter. When at the Contractor's option: Viega, LLC. Provide extended handle as required.
3. Ball valves are not acceptable for balancing the hot water return system.

2.7 STRAINERS

A. Manufacturer: Nibco, Watts, Crane or approved equal.

B. Two (2) inches and Smaller: Threaded (lead free) cast copper silicon alloy for 400 PSI WOG, wye pattern with 1/32 inch stainless steel perforated screen. Watts Series LF777.

C. 2-1/2 and Larger: Class 125, flanged (lead free) cast iron strainer for 200 PSI WOG, wye pattern with 1/16-inch stainless steel perforated screen. Watts Series 77F-DI-125.

D. Lead Free.

2.8 GAGES AND TAPS

A. Manufacturers: For portable water system (Lead Free)
1. Weiss
2. Marsh
3. Weksler
4. Dwyer
5. Trerice

B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Phosphor bronze.
3. Dial Size: 4-1/2 diameter.
4. Mid-Scale Accuracy: One (1) percent.
5. Scale: Psi.

C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

D. Ball Valve: Brass 1/4 inch NPT for 250 psi.

E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.

F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than two (2) feet of cover.

C. Establish minimum separation from other services piping in accordance with code.

D. Remove scale and dirt on inside of piping before assembly.

E. Install pipe on prepared bedding.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Do not use lead bearing solder materials.

I. Pipe Cover and Backfilling:
1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
3. Do not use wheeled or tracked vehicles for tamping.

J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

K. Trap primer lines shall be installed with no kinks, utilizing pipe benders as recommended in the Copper Development Association, Inc. “Copper Tube Handbook – Industry Standard Guide for the Design and Installation of Copper Piping Systems” handbook, Chapter 4, Bending. Hand bending of copper tube trap primers shall be prohibited.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.

B. Install non-conducting dielectric connections wherever jointing dissimilar metals.

C. Insulate all domestic hot water supply and return lines.

D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.

H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.

I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.

J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Install water piping in accordance with ASME B31.9.

M. Sleeve pipes passing through partitions, walls and floors.

N. Install unions downstream of valves and at equipment or apparatus connections.

O. Install valves with stems upright or horizontal, not inverted.

P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.

R. Provide check valves on discharge of all water circulating pumps.

S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.

V. Route all domestic water piping inside building in climate controlled space not subject to freezing.

W. Do not use lead bearing solder materials.

X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).

Y. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and lock in place.

Z. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.

AA. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
1. The manufacturer's installation instructions shall be strictly adhered to and shall follow ASTM B1029.
2. Installers shall attend a manufacturer's installation training class as having been trained and qualified to join piping with press-connect fittings. On-site training and credentialing by manufacturer's representative is acceptable.
3. All connections shall bear full insertion marks on the tubing.
4. Special attention shall be given to the required two step pressure test.
    a. Initial Smart Connect test for unpressed fitting detection per manufacturer's installation manual.
    b. Following a successful Smart Connect test, the system may be pressure tested up to 600 psi maximum hydrostatically (water) and 200 psi maximum pneumatically (air) if required by local code requirements.

BB. Lead Free.

CC. Trap primer lines shall be installed with no kinks, utilizing pipe benders as recommended in the Copper Development Association, Inc. "Copper Tube Handbook – Industry Standard Guide for the Design and Installation of Copper Piping Systems" handbook, Chapter 4, Bending. Hand bending of copper tube trap primers shall be prohibited.

3.5 INSTALLATION - SERVICE CONNECTIONS

A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.

B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.

C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing,

maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.

B. Provide at water supply to fire protection system.

C. Provide a floor drain within six (6) feet of each backflow preventer.

D. Backflow preventer shall be certified by Contractor.

E. Lead Free.

3.7 INSTALLATION – PRESSURE GAGES

A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping with isolation valves.

C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install gage in piping to each inlet and outlet of water heater.

E. Install gage in piping to each end of backflow preventer.

F. Install gage in piping to each end of double check valves.

G. Install gage in piping to each inlet and outlet of water softener.

H. Install gage in piping to each inlet of water filter.

I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.

B. Preparation of the hot water system for balancing:

1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
2. Verify recirculation pump operation and rotation.
3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.

C. The test and balance report shall indicate the following:

1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.

D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in “Permits” under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

A. Pressure test all domestic water piping.

B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.

C. Repair leaks and defects and re-test any portion of piping system that fails.

D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.

E. Cleaning of piping systems:
1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
3. Phase One: Initial flushing of system.
   a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until “potable water clear” and particles larger than 5 microns are removed.
   b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
4. Phase Two: Cleaning of Piping Systems:
   a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
   b. Flush system and replace with clean water.
5. Phase Three: Final flushing and rinsing:
   a. Flush and rinse until “potable water clear” and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
6. Submit status reports upon completion of each phase of work on each system.

F. Branch Connections:
1. Pipe 2” and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.

G. 2-1/2” through 36”. For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

H. See section 220500 for additional requirements.

END OF SECTION 22 11 16

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

A. Provide a complete sanitary drainage system.

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.
   2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of equipment and clean-outs.

B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SANITARY SEWER PIPING, BELOW GRADE

A. Manufacturers
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe/Soil Division
   4. Spears

B. PVC Pipe
   1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
   2. Solvent welded joints shall conform to IAPMO installation standards IS-9.
   3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled “Tracer Wire”. Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
   4. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

A. Manufacturers
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe/Soil Division

B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
   1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
      a. Acceptable Manufacturers: Ideal Tridon “Super Heavy Duty” or Husky SD-4000.
   3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.4 VENT PIPING, ABOVE GRADE

A. Manufacturers
   1. AB&I
   2. Charlotte Pipe and Foundry Co.
   3. Tyler Pipe/Soil Division

B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
   1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
      a. Acceptable Manufacturers: Ideal Tridon “Heavy Duty”, Tyler Wide Body or Husky HD-2000.

2.5 VENT PIPING, BELOW GRADE

A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.

B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and invert as indicated on Drawings.

B. Establish minimum separation from other services piping in accordance with code.

C. Remove scale and dirt on inside of piping before assembly.

D. Install with a uniform slope of not less than that required by the local plumbing code(s) with adopted amendments.

E. Install pipe on prepared bedding of bank sand, minimum of 2” depth on bottom of trench up to centerline of pipe.

F. Route pipe in straight line.

G. Excavation:
1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
2. Cut the bottom of the trench or excavation to uniform grade.
3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

H. Pipe Cover and Backfilling:
1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.
4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.

I. Disposal of excess material:
1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.

J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Establish invert elevations, install with a uniform slope of not less than that required by the local plumbing code(s) with adopted amendments. Maintain gradients.

B. Provide and installed cleanout as required by code and local AHJ.

C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

D. Install a floor clean out according to the following;
1. Not more than 40’ apart in all horizontal drain lines.
2. At each change of direction greater than 45 Deg.
3. At the base of each waste or soil stack.
4. Install floor cleanouts at elevation to accommodate finished floor.
5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.

E. Install a wall cleanout according to the following:
1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets were pipes penetrate the slab including water closets, lavatories and EDF’s.

F. Install a exterior cleanout according to the following:
1. Encase exterior cleanouts in concrete flush with grade.
2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.

G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

I. Install piping to maintain headroom. Do not spread piping, conserve space.

J. Group piping whenever practical at common elevations.

K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.

N. Install piping penetrating roofed areas to maintain integrity of roof assembly.

O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.

Q. Install bell and spigot pipe with bell end upstream.

R. Sleeve pipes passing through partitions, walls and floors.

S. Support cast iron drainage piping at every joint.

T. Water test all piping per code.

U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.

V. Slope all vent piping to allow for drainage.

W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.

X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.

Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.5 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner’s field representative. Submit a certificate of completion to owner.

3.6 FIELD QUALITY CONTROL

A. Separate trenches for water lines, sanitary, storm, and gas piping.

B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.

C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.

D. Foreign pipe and fittings unacceptable.

E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.

F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any

obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.

G. For additions and renovations, use camera to locate routing of underslab lines.

H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION 22 13 16

SECTION 22 14 13 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete storm drainage piping system.

B. Section Includes:
1. Storm Piping Below Grade

2. Storm (Including Overflow) Piping Above Grade

1.3 SUBMITTALS

A. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories.

2. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 STORM WATER PIPING, BELOW GRADE

A. Manufacturers
1. AB&I
2. Charlotte Pipe and Foundry Co.
3. Tyler Pipe/Soil Division
4. Spears

B. PVC Pipe
1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.

2. Provide tracer wire at all underslab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled “Tracer Wire”. Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.

C. Contractor Option: Provide a complete system of schedule 40 PVC with solvent welded joints.

D. Foam core PVC piping is not acceptable for any drainage system.

2.3 STORM WATER PIPING, ABOVE GRADE

A. Manufacturers
1. AB&I
2. Charlotte Pipe and Foundry Co.
3. Tyler Pipe/Soil Division

B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.

2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
   a. Acceptable Manufacturers: Ideal Tridon “Super Heavy Duty” or Husky HD-4000.
3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than two (2) feet of cover.

C. Establish minimum separation from other services piping in accordance with code.

D. Remove scale and dirt on inside of piping before assembly.

E. Install with a uniform slope of not less than that required by the local plumbing code(s) with adopted amendments.

F. Install pipe on prepared bedding of bank sand, minimum of 2” depth on bottom of trench up to centerline of pipe.

G. Route pipe in straight line.

H. Pipe Cover and Backfilling:
1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of pipe.

2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.

3. Do not use wheeled or tracked vehicles for tamping.

I. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.3 INSTALLATION - ABOVE GROUND PIPING

A. Establish invert elevations, install with a uniform slope of not less than that required by the local plumbing code(s) with adopted amendments. Maintain gradients.

B. Provide and installed cleanout as required by code and local AHJ.

C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearance at cleanout for snaking drainage system.

D. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch

and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

E. Install a floor clean out according to the following;
1. Not more than 40’ apart in all horizontal drain lines.
2. Install floor cleanouts at elevation to accommodate finished floor.
3. At each change of direction greater than 45 Deg.
4. At the base of each waste or soil stack.
5. Install floor cleanouts at elevation to accommodate finished floor.
6. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.

F. Install a wall cleanout according to the following:
1. Install a wall cleanout at every storm piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall.

G. Install a exterior cleanout according to the following:
1. Encase exterior cleanouts in concrete flush with grade.
2. Provide double cleanouts where building storm sewer system and civil sewage system intersect.

H. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines

I. Install non-conducting dielectric connections wherever jointing dissimilar metals.

J. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

K. Install piping to maintain headroom. Group piping to conserve space.

L. Group piping whenever practical at common elevations.

M. Support cast iron drainage piping at every joint.

N. Provide bracing at horizontal pipe and fittings larger than 4 inches in size. Pipe and fittings shall be suitably braced to prevent horizontal movement at every branch opening or change of direction by use of braces, blocks, rodding, or other suitable method as required to prevent movement or joint separation.

O. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

P. Provide clearance in hangers and from structure and other equipment for installation of insulation.

Q. Install piping penetrating roofed areas to maintain integrity of roof assembly.

R. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

S. Install bell and spigot pipe with bell end upstream.

T. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.

U. Provide heavy-duty clamps, fittings and gaskets at no-hub connections to all roof and overflow drains then transition to bell and spigot piping system.

V. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

W. Insulate all horizontal storm and overflow drain piping with fiberglass insulation with service jacket. For exposed locations provide rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow all the way to change to vertical direction, including y-fittings.

3.4 RODDING SEWERS

A. All storm lines, both in the building and out, shall be rodded out after completion of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

END OF SECTION 22 14 13

SECTION 22 20 23 - GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.

B. This section covers the complete first class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
   1. 2015 Edition of the International Fuel Gas Code.
   2. Latest Edition of NFPA 54, National Fuel Gas Code.
   3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.
   4. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories.

2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
   a. Strainers.
   b. Natural gas pressure regulators.
   c. Natural gas pressure relief valves.
   d. Tape form pipe coating.

B. Test Reports: Indicate results of piping system pressure test.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, piping system, and system components.

B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.

B. Valves: Manufacturer’s name, size, standards compliance and pressure rating clearly marked on outside of valve body.

C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

A. Products and materials listed herein are for references of approved materials.

B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 NATURAL GAS PIPING, BELOW GRADE

A. Steel Pipe: ASTM A53 Schedule 40 black.

1. Fittings: ASTM A234/A234M forged steel welding type.

2. Joints: ASME B31.9, welded.

3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

B. At the Contractor’s option: Provide Underground Gas Polyethylene (PE), SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.

1. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.

2. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

C. Tracer wire is required at underground gas piping outside the building (site).

2.4 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)

A. Piping 1½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

B. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.

C. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.
   1. Exterior piping at rooftops shall be painted yellow in accordance with OSHA requirements.
   2. Exterior piping at gas meter shall be painted gray.
      a. Exterior piping between gas meter and rooftop piping (e.g., vertical piping leading up to rooftop) shall be painted to match exterior wall color, the paint color shall be submitted to the Architect for approval.

2.5 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)

A. Steel Pipe: ASTM A53 Schedule 40 black.

B. Fittings
   1. ASME B16.3, malleable iron

   2. ASTM A234/A234M forged steel welding type.

   3. Joints: NFPA 54, threaded, welded to ASME B31.9 above 2” size.

   4. EXCEPTIONS:
      a. All exposed piping 1½ inches and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
      b. All exposed piping 1½ inches and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.6 UNIONS AND COUPLINGS

A. Ferrous pipe: 150 psi malleable iron threaded connections.

B. Dielectric Connections: Union with galvanized or plated steel threaded, copper solder end, water impervious isolation barrier.

2.7 VALVES

A. Manufacturers:
   1. Apollo.
   2. NIBCO.
   3. Milwaukee.
   4. Watts.
   5. Homestead Valve.

B. Ball Valves:

1. 1/4 inch to 2-1/2 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.

2. 3 to 4 inch, MSS SP 110, 250 psi, two piece, threaded ends, brass body, stainless steel ball, reinforced teflon seats, blow-out proof stem, lever handle, UL listed for flammable liquids and LPG, Full port. Nibco T-FP-600A (CSA, UL, FM).

3. 3 inch and larger, MSS-SP-78, Type IV, Class 125, ASME/ANSI B16.38, 200 psi, lubricated plug valves with flanged or threaded ends. Bodies, plugs and bonnets shall be made from Gray Iron castings, ASTM A-126, Class B. Homestead Valve series 600 (CSA, UL, FM).

2.8 STRAINERS

A. Manufacturers:
   1. O.C. Keckley Company or approved equal.

B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

A. Manufacturers:
   1. BelGas.
   2. Itron.
   3. Honeywell.
   4. Sensus.
   5. Maxitrol.
   6. Fisher.

B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
   1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.

   2. Body: Steel.

   3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.

   4. Disk, diaphragm, and O-ring: Nitrile.

   5. Maximum inlet pressure: 150 psig

   6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.10 NATURAL GAS PRESSURE RELIEF VALVES

A. Manufacturers:
   1. Fisher 289H, or approved equal.

B. Product Description: Spring loaded type relief valve.
   1. Body: Aluminum.
   2. Diaphragm: Nitrile.
   3. Orifice: Brass.
   4. Maximum operating temperature: 150 degrees Fahrenheit.
   5. Inlet Connections: Threaded.
   6. Outlet or Vent Connection: Same size as inlet connection.

2.11 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

2.12 PROTECTIVE COATING

A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using “Scotchwrap,” “CT Tapecoat” or “X-Tru-Tape.” Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

PART 3 - EXECUTION

3.2 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Establish minimum separation of gas pipe from other services, piping in accordance with code.

C. Install continuous jacket or tape.

D. Install gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

E. Install Work in accordance with Gas Company standards.

F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 PSI for 24 hours.

G. Provide pipe sleeve as required for gas pipe routing under slab or in conceal space.

H. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.

B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.

E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.

F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to piping cover up, minimum 50 PSI for 24 hours.

G. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 PSI. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

H. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.

I. Gas piping installed in plenums and chases shall be welded.

J. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10’ on center identifying pipe service type (gas, domestic water, storm water, etc.).

K. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.

L. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.

M. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.

N. Provide separate gas valves on each fixture in labs.

O. Provide a gas isolation valve on the lab controller unit.

P. Install a test port of each side of all natural gas pressure regulators.

Q. Perform a pressure test of all replaced natural gas piping.

R. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.

S. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

3.6 FIELD QUALITY CONTROL

A. Pressure test all natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.

B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

C. Press-Connect Carbon Steel Fittings for Steel Piping: Join carbon steel piping and press-connect fittings with tools recommended by fitting manufacturer.
   1. The manufacturer’s installation instructions shall be strictly adhered to.
   2. All connections shall bear full insertion marks on the pipe.
   3. Special attention shall be given to the required two step pressure test.
      a. Initial test for unpressed fitting detection shall be in accordance with manufacturer’s installation manual.
      b. Following a successful Smart Connect test, inspection, testing and purging of the fuel gas system shall be in accordance with local codes or, in the absence of local codes, in accordance with the International Fuel Gas Code, NFPA 54/National Fuel Gas Code z223.1, the Uniform Plumbing Code, NFPA 58 or CSA B 149.1 as applicable.

END OF SECTION 22 20 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete installation for each equipment type listed in this section.

B. Section Includes:
1. COMMERCIAL ELECTRIC WATER HEATERS
2. VACUUM RELIEF VALVES
3. IN-LINE CIRCULATORS
4. T & P RELIEF VALVES
5. DIAPHRAGM-TYPE EXPANSION TANKS
6. BACKFLOW PREVENTERS
7. WATER PRESSURE REGULATING VALVES
8. WATER HAMMER ARRESTORS
9. THERMOSTATIC MIXING VALVES
10. FLOW METER
11. TEMPERATURE INSTRUMENTS

1.3 SUBMITTALS

A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.

B. Manufacturer's Installation Instructions: Submit mounting and support requirements.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept all equipment on site in original labeled cartons. Inspect for damage.

B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

A. Furnish two pump seals.

PART 2 - PRODUCTS

2.5 COMMERCIAL ELECTRIC WATER HEATERS (EWH-x)

A. Manufacturers:
1. A.O. Smith.
2. Bradford White.
3. American Water Heater.
4. Rudd.
5. State.
6. Rheem.
7. All electric point-of-use storage tank type water heaters provided within this project shall be the product of one manufacturer.

B. Furnish and install a Factory-assembled and wired, electric, vertical storage domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.

C. Water heater(s) shall have the UL seal of certification and be factory equipped with an ASME rated temperature and pressure relief valve. Water heater(s) shall be constructed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section IV Part HLW. Tank(s) shall have a coating of high temperature porcelain enamel and furnished with two (2) magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 160 psi and shall be completely assembled.

D. Tank: Shall be insulated with 2-1/2" of rigid polyurethane foam insulation or with minimum two (2) inches glass fiber polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.

E. Controls: Equip with diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120-volt control circuit transformer and immersion thermostat(s) with manual reset high limit control.

F. Water heater(s) shall capable for remote monitoring, Controls, leak detection and fault alert.

G. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 3, 5, or 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.

H. Capacity:
1. Storage capacity: 10 gal or as indicated.
2. Heating element size: 3 kW or as indicated.
3. Number of heating elements: 1 or as indicated.
4. Minimum recovery rate: (as indicated) gph with 100 degrees Fahrenheit temperature rise.
5. Maximum working pressure: 160 psig.
6. Provide integral heat traps.
7. Provide drain pan.

I. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.7 VACUUM RELIEF VALVES

A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.

B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.8 IN-LINE CIRCULATORS

A. Manufacturers:
1. Bell and Gossett
2. Taco
3. Aurora
4. Armstrong
5. Grundfos

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 80 psig, 150 psig maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Cast bronze, dynamically balanced and keyed on shaft.

E. Bearings: Two, oil lubricated bronze sleeve, integral thrust collar.

F. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.

G. Drive: Flexible coupling.

H. CP-1, 1/6 HP or as scheduled and fitted with remote heat sensing aqua-stat and timer.

I. Aqua-stat: Honeywell – Model L4006A1009 (100 – 240 degree range) or approved equal by Johnson Controls and Dayton.

J. Timer: Armstrong – Model 810233-130 or approved equal by Taco, Bell and Gossett, Grundfos, or Armstrong

2.9 T & P RELIEF VALVES

A. Manufacturers: Watts Industries or approved equal.

B. Temperature and Pressure Relief:
1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.

C. Vacuum Relief Valves:
1. Watts N36 Lead Free Series.

2.10 DIAPHRAGM-TYPE EXPANSION TANKS

A. Manufacturers: Bell & Gosset PT Series or approved equal.

B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

D. Provide separate support to structure for expansion tank

2.25 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers
1. Comply with ASSE 1013.
2. Bronze body, with bronze internal parts and stainless-steel springs.
3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
4. Manufacturers:
   a. Watts Series LF909

B. Double Check Valve Assemblies:
1. Comply with ASSE 1012.
2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
4. Manufacturers:
   a. Watts Series LF007

C. Dual Check Valves:
1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.

3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
4. Manufacturers:
   a. Watts Model LF SD-2/9BD

D. Lead Free

2.26 WATER PRESSURE REGULATING VALVES

A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
1. Sizes 1/2" through 2"
2. All bronze body
3. 0.25% maximum weighted average lead content
4. Integral stainless-steel strainer screen
5. Built-in bypass check valve
6. FDA approved elastomers
7. Renewable seat
8. Union end connection
9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
10. Manufactured by Wilkins Series 600XL or approved equal by Watts

B. Large Demand Systems
1. Sizes 1-1/4” through 2 - ASTM B62 bronze body
2. Sizes 2-1/2” and larger - ASTM A536 ductile iron body
3. Pressure reducing pilot control
4. Stainless steel disc guide, seat and bearing cover
5. Stainless steel stem, nut and spring
6. FDA approved Nylon reinforced Buna-N rubber diaphragm
7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
8. Cla-Val Company Series 90 or approved equal by Watts

2.27 WATER HAMMER ARRESTORS

A. Manufacturers: Watts Series LF15M2 (NPT solid hex brass adapter) or approved equal.

B. ANSI A112.26.1; copper construction, lead-free, piston type sized in accordance with PDI WH-201.

C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.

D. Access Panel: Acorn Model 8292 or approved equal.

2.28 THERMOSTATIC MIXING VALVES:

A. Manufacturers:
1. Leonard
2. Symmons
3. Bradley

B. Certified to ASSE 1017 (at water heater), ASSE 1070 (at point-of-use), and meets the anti-scald requirements of ASSE 1016.

C. Capacity:
1. TMV-1: ASSE 1070. Flow capacity between 0.25 GPM (minimum) and 4 GPM (maximum), 5 PSI pressure drop, lead free, mounted in piping under lavatory/sink/etc.
(1) Model (basis of design): Leonard 170-LF-CP

2. TMV-2: ASSE 1017. Flow capacity up to 11 GPM (maximum), 5 PSI pressure drop, ¾" inlets and 1" outlet, lead free. Install and locate immediately at water heater hot water ¾" outlet.
(1) Model (basis of design): Leonard TM-420B-LF-DT-CP

3. TMV-3: ASSE 1017. Flow capacity up to 19 GPM (maximum), 5 PSI pressure drop, ¾" inlets and 1" outlet, lead free. Locate and install immediately at water heater hot water 1" outlet.
(1) Model (basis of design): Leonard TM-520B-LF-DT-CP

4. TMV-4: ASSE 1017. Flow capacity up to 26 GPM (maximum), 5 PSI pressure drop, 1" inlets and 1-¼" outlet, lead free. Locate and install immediately at water heater hot water 1-¼" outlet.
(1) Model (basis of design): Leonard TM-820B-LF-DT-CP

D. Accessories:
1. Check valve on inlets.
2. Volume control shut-off valve on outlet.
3. Stem thermometer on outlet.
4. Strainer stop checks on inlets.
5. Wall supports as required.

E. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.

F. Mechanical Rooms, Central Plants, Boiler Rooms: Omit cabinet, surface mount.

G. Lead Free.

2.29 FLOW METER

A. Water meter
1. Provide clamp-on ultrasonic water flow meter at the main water point of entry or as indicated on plan.
2. Provide Onicon F-4300 meter with the followings.
a. Accuracy +/- 1.0% of reading from 1.6 ft/s to 20 ft/s
b. Repeatability +/- 0.25 % of reading
c. Bi-directional flow range of 1.6 to 40 ft/s
d. Process pipe-wall temperature: 32°F to140°F
e. Power supply: 120VAC , 60 Hz, 10 VA max. .(provide transformer as needed)
f. Output signals:
(1) 4-20 mA DC current output
(2) Pulse (configurable)
(3) Relay (configurable)
g. Digital communications: RS-232, RS-485, Modbus RTU
h. Materials:

(1) Enclosure NEMA 4X
(2) Transducers IP68 (Encapsulated)
i. Standard cable length: 25 ft (9 m), Maximum cable length: 100 ft (30 m)
3. Acceptable Manufacturers:
a. Sierra
b. Siemens
c. Dynasonics
d. Onicon

B. Natural gas meter
1. Provide insert mass flow meter at the main water point of entry or as indicated on plan.
2. Provide Onicon F-5500 meter with the followings.
a. Accuracy +/- 0.5% of reading from 0.16 ft/s to 20 ft/s
b. Repeatability +/- 0.25 % of reading
c. Bi-directional flow range of 0.16 to 40 ft/s
d. Process pipe-wall temperature: 32°F to140°F
e. Input power: 12-28 VDC, 6 W min.
f. Power supply: 120VAC , 60 Hz, 10 VA max.(provide transformer as needed)
g. Output signals:
(1) 4-20 mA DC current output
(2) Pulse (configurable)
(3) Relay (configurable)
h. Digital communications: RS-232, RS-485, Modbus RTU
i. Materials:
(1) Enclosure NEMA 4X
(2) Transducers IP68 (Encapsulated)
j. Standard cable length: 15 ft (9 m), Maximum cable length: 100 ft (30 m)
3. Acceptable Manufacturers:
a. Sierra
b. Thermal Instrument Co.
c. Dynasonics
d. Onicon

C. Warranty
1. Products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to the owner, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery

2.30 TEMPERATURE INSTRUMENTS

A. Manufacturer: Trerice, Marsh, Weksler, Weiss, Dwyer.

B. Thermometer Wells.
1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
4. Wells shall be sized to extend a minimum of 50% into pipe

2.31 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00

B. Install water heater with the followings.

1. Maintain manufacturer's recommended clearances around and over water heaters.

2. Connect natural gas piping in accordance with NFPA 54.

3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.

4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.

5. Install the following piping accessories.

a. On supply:

(1) Thermometer well and thermometer.

(2) Strainer.

(3) Pressure gage.

(4) Shutoff valve.

(5) Diaphragm-type expansion tank

b. On return:

(1) Thermometer well and thermometer.

(2) Pressure gage.

(3) Shutoff valve.

6. Install the following piping accessories on natural gas piping connections.

a. Strainer.

b. Pressure gage.

c. Shutoff valve.

d. Pressure reducing valve.

7. Install discharge piping from relief valves and drain valves to nearest floor drain.

8. Install circulator and diaphragm expansion tank on water heater.

9. Install water heater trim and accessories furnished loose for field mounting.

10. Install electrical devices furnished loose for field mounting.

11. Install control wiring between water heater control panel and field mounted control devices.

12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.

13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.

C. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

1. Install the following piping accessories.

a. On supply:

(1) Pressure gage.

(2) Shutoff valve.

(3) Check valve.

b. On return:

(1) Thermometer well and thermometer.

(2) Timer.

(3) Pressure gage.

(4) Shutoff valve.

D. Water softener: Install system components according to manufacturer’s published recommendations and pipe as indicated on Drawings. Care shall be exercised in fabricating plumbing lines to avoid all cross connections eliminate the possibility of water contamination.

1. Provide and install double check valve assembly backflow prevention on the potable water line serving the water softener downstream of all potable water connections serving any other outlets or equipment.

2. Backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (twenty-four hour) water service is required.

3. Provide a physical air gap of at least two times the diameter of the softener equipment drain piping discharging into a floor drain/sink receptor.

4. Provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation and acquaint the operators with the proper operation and maintenance of the equipment.

E. Backflow Preventers and Vacuum Breakers.

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.

2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.

3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.

4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.

5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.

6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.

F. Water Hammer Arrestors (Hydraulic Shock Absorbers).

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.

2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer’s published recommendations.

3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.

G. Water Pressure Regulating Valves.

1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.

2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.

3. Installation shall allow sufficient access to and space around components for adjustments and servicing.

4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators

H. Grease traps shall be cleaned and pumped prior to substantial completion. Interior joints shall be properly sealed.

I. Install diaphragm-type expansion tank on cold water supply line.

J. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.

K. Sewer and Sump pump Discharge Piping:

1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.

2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS

E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

A. Provide a complete system of plumbing fixtures and trim.

B. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

1.3 SUBMITTALS

A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

A. Fixture Manufacturers:

1. American Standard.

2. Sloan.

B. Fixture Trim Manufacturers:
1. American Standard.

2. Sloan.

C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps. Provide as indicated on plumbing fixture schedule.
1. Wall Mounted: American Standard 3351.101.020
2. Or as indicated on schedules.
3. Trim : (Type C)

D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
1. Wall Mounted: American Standard 3351.101.020
2. Or as indicated on schedules.
3. Trim : (Type C)
4. Provide flush valve stem offset as required.

E. Trim:
1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, 2” offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Royal 111 Series and ADA version where required.

F. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Bemis 1655SSCT or provide as indicated on plumbing fixture schedule.

G. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Provide concealed flush valve support option. or equal by Zurn, Wade, Josam, Mifab.

2.2 WALL HUNG URINALS

A. Fixture Manufacturers:
1. American Standard.

2. Sloan.

B. Fixture Trim Manufacturers:
1. American Standard.

2. Sloan.

C. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the

Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

D. U-1: ASME A112.19.2M; vitreous china, wall hung, elongated rim integral trap, removable stainless steel strainer, 3/4 inch top spud, provide chair carrier as required. American Standard Pintbrook Model 6002.001 or provide as indicated on plumbing fixture schedule.
   1. Trim : (Type C)

E. U-2: Same as U-1, except mounted at ADA/TAS height for appropriate age group.
   1. Trim : (Type C)

F. Trim:
   1. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, integral screwdriver stop with vandal resistant stop cap, vacuum breaker; maximum one (1) pint flush volume. Sloan Royal 186 Series and ADA version where required..

G. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with rectangular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. Provide bottom bearing plate. Provide concealed flush valve support option. Jay R. Smith figure 0637, or equal by Zurn, Wade, Josam, Mifab.

2.3 LAVATORIES

A. Fixture Manufacturers:
   1. American Standard.
   2. Sloan.

B. Fixture Trim Manufacturers:
   1. Chicago.

C. Supply Fittings Manufacturers:
   1. Chicago.
   2. McGuire.
   3. Brasscraft.
   4. Zurn.

D. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

E. L-1, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0355.012 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.

1. Trim : (Type A1)

F. L-2, Vitreous China Wall Hung Basin: ASME A112.19.2M; American Standard 0356.421 vitreous china wall hung lavatory 21 x 18 inch minimum, with four (4) inch high back, single deck hole, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type. Provide as indicated on plumbing fixture schedule.
   1. Trim : (Type A1)

G. Trims:
   1. Supply Fitting: ASME A112.18.1 (Type A1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 1.5 gpm flow, ADA compliant. Chicago Faucet 857-765PSHABCP.

H. Accessories:
   1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
   2. Chrome plated 17 gage open grid P. O. plug.
   3. Removable key stops.
   4. Flexible supplies.
   5. Trap and waste insulated and offset to meet ADA compliance.
   6. Tempering valve – Power LFe480 series, Acorn, or Leonard.

I. Floor Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs. Jay R. Smith 710 Series, or equal by Zurn, Wade, Josam, Mifab.

2.4 LAVATORY and SINK INSULATION KIT

A. Manufacturers:
   1. Truebro/IPS
   2. Plumberex
   3. Zurn

B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

2.5 ELECTRIC DRINKING FOUNTAIN

A. Manufacturers:
   1. Elkay Mfg.
   2. Halsey Taylor

B. Supply Fittings Manufacturers:

1. Chicago.
2. McGuire.
3. Brasscraft.
4. Zurn.

C. All soldering, materials, fixtures, and equipment for the potable water system shall meet the latest amendments, mandates, and laws for lead-free requirements as codified by the Reduction of Lead in Drinking Water Act (RLDWA) effective January 2014, and as codified by the Safe Drinking Water Act (SDWA) effective October 2020.

D. Fountain: (EDF-1) Indoor With Bottle Filler
1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Halsey Taylor Model HTHB-HAC8BLSS-NF provide as indicated on plumbing fixture schedule.
2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
3. Electrical: 115V / 60HZ. Maximum 1/5 hp compressor, cord and plug for connection to electric wiring system including grounding connector.
4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.
5. Carrier by Jay R. Smith, or equal by Zurn, Wade, Josam, Mifab

2.6 SERVICE SINKS (SS-1)

A. Manufacturers:
1. Fixture Manufacturers:
   a. Fiat Products
   b. Florestone
   c. Stern Williams
   d. Zurn
2. Fixture Trim Manufacturers:
   a. Chicago Faucet Co.
   b. Fiat Products
   c. Stern Williams
   d. T & S Brass & Bronze Works Inc.
   e. Zurn

B. SS-1: 12” corner type w/drop front, bowl 32 x 32 x 12 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer, floor mounted. Stern Williams Model SBC-1725 or provide as indicated on plumbing fixture schedule.

C. Accessories:
1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric

adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.

2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.

3. Mop hanger. Stern Williams Model T-40.

4. Or provide as indicated on plumbing fixture schedule

2.7 FLOOR DRAINS

A. Manufacturers:
1. Josam Mfg.,

2. Jay R. Smith Mfg.,

3. Wade Spec. Products

4. Zurn Industries

5. Mifab

B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

C. Floor Drain (FD-2): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable light duty square nickel-bronze strainer with removable perforated sediment bucket. Zurn ZN-415N-P (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.8 FLOOR SINKS

A. Manufacturers:
1. Josam Mfg.

2. Jay R. Smith Mfg.

3. Wade Spec. Products

4. Zurn Industries

5. Mifab

B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.9 TRAP SEAL PRIMERS

A. Manufacturers:
1. PPP Inc.
2. Jay R. Smith Mfg.
3. Siouxchief
4. Zurn Industries
5. Mifab
6. Watts

B. Trap Seal Primers-Pressure Drop Type (TP-1)
1. Adjustable to the static line pressure by use of the adjusting screw. System operating range is 20 psi minimum to 80 psi. The trap Primer is to be connected to a cold water supply with isolation valve.
   a. PPP Model P1-500 will prime 1-4 floor drains using DU-U Distribution unit.
   b. PPP Model P2-500 will prime 1-2 floor drains using DU-U Distribution unit.

C. Trap Seal Primers-Flush Valve Type (TP-2)
1. Vacuum breaker trap primer attached to water closet flush valve, similar to Zurn model P6000-TPO.

D. Trap Seal Primer: (TP-3), Jay R. Smith 2699 Series.

E. Trap Seal Primers-electronic Type (TP-E)
1. Vacuum breaker trap primer attached to water supply manifold, similar to Zurn Z-1020 with copper waterway.
2. Accessories:
   a. Slow closing 24 VAC solenoid valve.
   b. 120 – 24 VAC transformers.
   c. Brass atmospheric vacuum breaker.
   d. Copper connection outlets

2.10 CLEANOUTS

A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers

B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.

C. Manufacturers:

1. Josam Mfg.
2. Jay R. Smith Mfg.
3. Wade Spec. Products
4. Zurn Industries
5. Mifab
6. Watts

D. Floor, Outdoors (DCOTG or COTG): Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.

E. Floor, Indoors (FCO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.

F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.

G. Floor, Stainless Steel Indoors (FCO-SS): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

2.11 ROOF DRAINS

A. Roof Drain (RD-1):
1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable cast iron dome with vandal proof screws.
4. Accessories: Coordinate with roofing type, provide all required accessories:
   a. Membrane flange and membrane clamp with integral gravel stop.
   b. Under deck ring with wide flange.
   c. Roof sump receiver.
   d. Waterproofing flange.
   e. Adjustable threaded extensions collar, bearing pan with SS hardware.
5. Model:
   a. Josam – 21500-AE-CR-1-22-VP
   b. J. R. Smith – 1015-CID-C-R-U
   c. Zurn – ZC100F-C-DR-R-VP
   d. Wade – 3000-42-AE-VP-52-189
   e. MIFAB – R1200-6-B-BA-E-M-U

B. Overflow Roof Drain (OD-1):
1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4.
2. Body: Lacquered cast iron with sump.

3. Strainer: Removable cast iron dome with vandal proof screws.

4. Waterdam extended to two (2) inches above flood elevation.

5. Accessories: Coordinate with roofing type:
   a. Membrane flange and membrane clamp with integral gravel stop.
   b. Adjustable under deck clamp.
   c. Roof sump receiver.
   d. Waterproofing flange.
   e. Adjustable threaded extensions collar, bearing pan with SS hardware.

6. Model:
   a. Josam – 21500-AE-CR-1-22-VP
   b. J. R. Smith – 1045-CID-C-R-U
   c. Zurn – ZC100F-C-DR-R-VP-89
   d. Wade – 3000-42-AE-VP-52-189-D
   e. MIFAB – R1200-6-B-BA-E-M-U-W2

C. All roof drains shall be provided with no-hub connection.

2.12 HOSE BIBS

A. Manufacturers:
1. Josam Mfg.

2. Jay R. Smith Mfg.

3. Woodford

4. Zurn Industries

5. Chicago

6. Wade

B. HB-1:
1. Manufacturers: Woodford Model B24 or provide as indicated on plumbing fixture schedule.

2. Interior: Polish brass, anti-siphon, vacuum breaker, enclosed in flush mounted wall box and adjustable brass nut with deep stem guard.

C. HB-2:
1. Manufacturers: Woodford Model B65, or provide as indicated on plumbing fixture schedule.

2. Interior: Polish brass Bronze, automatic draining freezeless wall hydrant, single check hose connection anti-siphon vacuum breakers, hydrants drain as handle shut off , permanent type brass valve body with hemispherical seating surface.

D. HB-3:
1. Manufacturers: Woodford Model 24 or provide as indicated on plumbing fixture schedule.

2. Interior: Polish brass, anti-siphon, vacuum breaker and adjustable brass nut with deep stem guard.

2.13 WALL HYDRANTS

A. Manufacturers:
1. Josam Mfg.
2. Jay R. Smith Mfg.
3. Woodford.
4. Zurn Industries
5. Mifab
6. Watts

B. Exterior Wall Hydrant (WH-1):
1. Woodford RB67 Series, with box enclosure, freezeless, or provide as indicated on plumbing fixture schedule.
2. ASSE 1019; Chrome, freezeless, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.

C. Roof Hydrant (WH-4):
1. Woodford SRH-MS, ASSE 1057, or provide as indicated on plumbing fixture schedule.
2. The hydrant Features:
   a. The hydrant valve body is drilled and tapped with 1/8” drain hole which must be piped to a drain location.
   b. Rod guide eliminates side pull on rod, reduces wear on packing, packing nut & stem.
   c. Adjustable link for easy adjustment and positive lever lock tension.
   d. One piece variable flow plunger with large cushion type seal.
3. All necessary mounting hardware for proper installation on a commercial roof is supplied, including a 2 degree shim for pitch adjustment.
4. Contractor to route drain line to the nearest floor receptor as applicable. Pitch drain line uniformly toward drain outlet.

2.14 RECESSED VALVE BOX

A. Manufacturers: Guy Gray, or approved equal.

B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.

C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

2.15 DOWNSPOUT OVERFLOW

A. Hinged Cover Style:
   1. Manufacturers: Jay R. Smith 1775-U Series or provide as indicated on plumbing fixture schedule.
   2. Product Description: Fabricated Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.

B. Verify walls and floor finishes are prepared and ready for installation of fixtures.

C. Verify electric power is available and of correct characteristics.

D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

F. For ADA accessible water closets, install flush valve with handle to wide side of stall.

G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.

H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.

M. Provide power wiring, including control power transformers as required for all sensor type fixtures.

N. Bolt carriers to the floor.

O. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.

B. All materials and distribution, and utilization equipment shall be UL Listed.

C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.

C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.

D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.

E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.

H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.

I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 COORDINATION DRAWINGS

A. Per Tomball ISD Construction Standards prior to beginning of any work, the Mechanical Contractor shall furnish as part of the mechanical equipment submittals, a ¼" = 1'-0" scaled drawings of all proposed equipment indicating accurate sizes and characteristics as well as clearances, piping routes, and all other detail as required to allow the Engineer, Architect, and Tomball ISD the opportunity to approve the proposed layout and equipment. Every effort shall be made to prevent "stacking" of systems above the ceiling which makes future maintenance or repair difficult or impossible. A scaled shop drawing of each central plant / boiler room / pump room / mechanical / electrical / technology room will be required to ensure all coordination of all trades within each room.

1.6 DRAWINGS

A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All

exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.7 SUBMITTALS

A. Provide shop drawings and complete product data as indicated in each specification section.

B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.

C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:

1. **Reviewed**: No further submittal action is required. Submittal to be included in O & M Manual.

2. **Revise and Resubmit**: Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.

3. **Rejected**: Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.

4. **Furnish as Corrected**: Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.

D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.

E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.8 SUBSTITUTIONS OF PRODUCTS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.

D. The Engineer and Owner reserve the right to disapprove of the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.

E. Availability of specified items:

1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.

2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.

3. The request will not be considered if the product or method cannot be provided as a result of the Contractor’s failure to pursue the work promptly or coordinate activities properly.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

F. A request constitutes a representation that Offeror:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.

2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

G. <u>No substitutions will be considered after the Award of Contract.</u>

1.9 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.10 INTERFERENCE DRAWINGS

A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.

B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.12 GENERAL ELECTRICAL REQUIREMENTS

A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.

B. Electrical materials and work provided shall be in accordance with Division 26.

C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.13 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.

B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).

C. Electric Motors:

1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.

2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.

3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

4. Contractor shall verify electrical characteristics of each motor with electrical drawings.

5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.

6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.

7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.

B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.

C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

D. Refer to individual equipment specifications for additional training requirements.

3.2 WARRANTY NOTIFICATION PROCESS – CENTRAL PLANT EQUIPMENT:

A. District notifies general contractor via phone and/or text of an alarm or error on central plant equipment (chiller, cooling tower, pumps, boiler), followed by a warranty work order via owner designated project management software. GC acknowledges receipt via owner designated project management software and initiates the warranty resolution process.

B. General contractor will notify their internal warranty team to issue a formal warranty sheet indicating campus, date, time and alarm detail information.

C. General contractor warranty representative will send via email the formal warranty sheet as an attachment to the following design and subcontracting team members:

1. District construction representative (Note: GC will also upload the formal warranty sheet to owner designated project management software for warranty resolution status / progress purposes)
2. Project mechanical contractor project manager
3. Project controls contractor
4. Project test / balance contractor
5. Project Architect
6. Project Design engineer project manager
7. Project Commissioning Agent
8. Local chiller or boiler manufacturer – depending on alarm condition.

D. Once the warranty is resolved, a detailed description of the resolution shall be filled out on the warranty form by the subcontractor or general contractor and then resent to all notification parties on what corrective action was performed. The GC will ensure that the resolution description is also uploaded to the owner designated project management software, either as a comment or by attaching the filled-out warranty form.

E. Warranty stays open until item is resolved.

F. Once warranty item is resolved, warranty item is officially closed in general contractor system and in the owner designated project management software.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.

B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.

C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.3 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association:

1. NEMA MG 1 – Motors and Generators.

C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Baldor
2. Marathon
3. General Electric
4. Weg
5. A.O. Smith

B. Motors 3/4 hp and Larger: Three-phase motor as specified below.

C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.

D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.

E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.

1. Service Factor: 1.15

2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEAO.

3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

4. Insulation System: NEMA Class F.

5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing loud with NEMA standard shaft extension. Stamp bearing sized on nameplate.

7. Sound Power Levels: Conform to NEMA MG 1.

8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.

F. Single Phase Motors:

1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.
2. Service Factor: 1.35.

G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:

1. Starters and motors specified as part of a packaged piece of equipment.

2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.

3. Variable speed controllers for variable volume air handling units and cooling towers.

B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.

C. Provide a tabulation of matched motors and starters provided under Division 23.

D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.

E. Efficiency: Minimum full load efficiency shall be as follows:

	Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)		
	1200 RPM	**1800 RPM**	**3600 RPM**		**1200 RPM**	**1800 RPM**	**3600 RPM**
HP	**Minimum Efficiency**	**Minimum Efficiency**	**Minimum Efficiency**	**HP**	**Minimum Efficiency**	**Minimum Efficiency**	**Minimum Efficiency**
1	82.5	85.5	77.0	**1**	82.5	85.5	77.0
1.5	86.5	86.5	84.0	**1.5**	87.5	86.5	84.0
2	87.5	86.5	85.5	**2**	88.5	86.5	85.5
3	88.5	89.5	85.5	**3**	89.5	89.5	86.5
5	89.5	89.5	86.5	**5**	89.5	89.5	88.5
7.5	90.2	91.0	88.5	**7.5**	91.0	91.7	89.5
10	91.7	91.7	89.5	**10**	91.0	91.7	90.2

15	91.7	93.0	90.2	**15**	91.7	92.4	91.0
20	92.4	93.0	91.0	**20**	91.7	93.0	91.0
25	93.0	93.6	91.7	**25**	93.0	93.6	91.7
30	93.6	94.1	91.7	**30**	93.0	93.6	91.7
40	94.1	94.1	92.4	**40**	94.1	94.1	92.4
50	94.1	94.5	93.0	**50**	94.1	94.5	93.0
60	94.5	95.0	93.6	**60**	94.5	95.0	93.6
75	94.5	95.0	93.6	**75**	94.5	95.4	93.6
100	95.0	95.4	93.6	**100**	95.0	95.4	94.1
125	95.0	95.4	94.1	**125**	95.0	95.4	95.0
150	95.4	95.8	94.1	**150**	95.8	95.8	95.0
200	95.4	95.8	95.0	**200**	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.

B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.

B. Install rotating equipment in static and dynamic balance.

C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.

D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer has an existing independent service organization.

B. The drive and all necessary controls as specified herein shall be supplied by the drive Manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.

C. For Air Handling Units with multiple fans (Fan Array) and motors, VFD manufacturer shall provide internal individual motor overloads to match quantity of fan motors. Refer to Air Handling Unit Schedule for fan motor quantity

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)

    a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriter’s laboratories

    a. UL508C

3. National Electrical Manufacturer’s Association (NEMA)

    a. ICS 7.0, AC Adjustable Speed Drives

4. IEC 16800 Parts 1 and 2

B. Testing:

1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 degrees Fahrenheit at full rated load, on a motor. Drive input power shall be continuously cycled for maximum stress and thermal variation.

2. All testing and manufacturing procedures shall be ISO 9001 certified.

EQUIPMENT SHALL BID AS AN ALTERNATE

C. Failure Analysis:

1. VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

D. Qualifications:

a. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Submit VFD's only after coordination with approved Air Handling Units, Pumps, and Cooling Tower Submittals (If applicable).

C. All Variable Frequency Drives serving various equipment such as but not limited to: Air handling Units, Pumps and Cooling towers shall be supplied by the same manufacturer.

D. Submittals shall include, as a minimum, the following information:

1. Outline Dimensions

2. Weight

3. Compliance to IEEE 519 - harmonic analysis for particular job site including total harmonic voltage distortion and total harmonic current distortion.

a. The VFD manufacture shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than five (5) percent. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior VFD installation.

b. If the voltage THD exceeds five (5) percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.5 WARRANTY

A. The warranty shall be (2) two years and shall begin from date of Certificate of Substantial Completion. The warranty shall include all parts, labor, travel time and expenses to provide on-site warranty.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.

B. The contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.7 MANUFACTURERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

PART 2 - PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

A. The adjustable frequency drives (VFD's) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (NEMA 3R if outdoors or unconditioned space), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.

1. Input 480 VAC +/- 10 percent, 3 phase, 48-63 Hz. The overvoltage trip level shall be 30 percent over the nominal, and the under-voltage trip level shall be 35 percent over the nominal voltage as a minimum.

2. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.

EQUIPMENT SHALL BID AS AN ALTERNATE

3. Environmental operating conditions: 0 to 104 Degree Fahrenheit, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing.

4. Conditioned indoors enclosure shall be rated NEMA 1 and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.

5. VFD's located in un-conditioned spaces or outdoors shall have rated NEMA 4X enclosure and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.

B. All VFD's shall have the following features:

1. All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.

2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the VFD will be started, and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bump less transfer" of speed reference when switching between "Auto" and "Hand" modes and vice-versa.

3. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to ACS400-US-reprogram all parameters and customer interfaces for a particular application to reduce programming time.

4. The VFD shall have the ability to automatically restart after an over current, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.

6. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.

7. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be

programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.

8. The customer terminal strip shall be isolated from the line and ground.

9. The drive shall employ current limit circuits to provide trip free operation:

   a. The Slow Current Regulation limit circuit shall be adjustable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.

   b. The Current Switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.

10. The overload rating of the drive shall be 110 percent of its normal duty current rating for one (1) minute in every ten (10) minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-plole motors.

11. The VFD shall have an integral Line Reactor(s) to reduce the harmonics to the power line and to increase the fundamental power factor. The minimum impedance shall be three (3) percent.

12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.

13. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.

14. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.

15. The following operators shall be provided:

   a. Bypass Hand-Off-Auto

   b. Drive mode selector

   c. Bypass mode selector

   d. Bypass fault reset

16. The following indicating lights (LED type) shall be provided:

   a. Power-on

   b. External fault

EQUIPMENT SHALL BID AS AN ALTERNATE

c. Drive mode selected

d. Bypass mode selected

e. Drive running

f. Bypass running

g. Drive fault

h. Bypass fault

i. Automatic transfer to bypass selected

17. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.

18. The following relay (form C) outputs from the bypass shall be provided.

a. Drive run
b. Bypass run

c. Drive fault Bypass fault (motor overload or under load (broken belt)

19. Automatic or manual bypass (field selectable)

20. Manual or automatic bypass fault (field selectable)

21. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure.

22. Door interlocked pad lockable circuit breaker which will disconnect all input power from the drive and all internally mounted options.

23. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted.

24. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.

C. All VFD’s to have the following adjustments:

1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and

be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.

3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.

4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock) drive is to resume normal operation.

5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.

7. Seven (7) programmable preset speeds.

8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.

9. The VFD shall Ramp or Coast to a stop, as selected by the user.

D. The following operating information displays shall be standard on the VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency

2. Motor Speed (RPM, percent, or Engineering units)

3. Motor Current

4. Calculated Motor Torque

5. Calculated Motor Power (kW)

EQUIPMENT SHALL BID AS AN ALTERNATE

6. DC Bus Voltage
7. Output Voltage
8. Heat sink Temperature (0°F)
9. Analog Input Values
10. Analog Output Value
11. Keypad Reference Values
12. Elapsed Time Meter (resettable)
13. kWh meter (resettable)
14. mWh meter
15. Digital input status
16. Digital output status

E. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).

1. Over current trip 350 percent instantaneous (170 percent RMS) of the VFD's variable torque.
2. Current rating.
3. Overvoltage trip 130 percent of the VFD's rated voltage.
4. Under voltage trip 65 percent of the VFD's rated voltage.
5. Over temperature +90 degrees Celsius.
6. Ground Fault either running or at start.
7. Adaptable Electronic Motor Overload (I 2 t). The Electronic Motor Overload protection hall protects the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL approved for this function.

F. Speed Command Input shall be via:

1. Keypad.
2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Serial Communications

G. Serial Communications

1. The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet. Optional protocols that must be available are Johnson Controls N2 bus, Siemens Building Technologies FLN, LonWorks, Profibus and DeviceNet.

2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.

3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

PART 4 - EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with drive products offered shall be locally available at both the specifying and installation locations.

EQUIPMENT SHALL BID AS AN ALTERNATE

END OF SECTION 23 05 14

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Expansion joints.
2. Pipe alignment guides.
3. Pipe anchors.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.

2. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in heating and cooling systems.

1.3 DESIGN REQUIREMENTS

A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

B. Expansion Compensation Design Criteria:

1. Installation Temperature: 50 degrees Fahrenheit.
2. Hot Water Heating System Temperature: 210 degrees Fahrenheit.
3. Domestic Hot Water: 140 degrees Fahrenheit.
4. Safety Factor: 30 percent.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered professional engineer.

C. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.

E. Manufacturer's Installation Instructions: Submit special procedures.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.

H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Amber / Booth
2. Triplex
3. Mason Industries

B. Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
2. Maximum Compression: 1-3/4 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: As specified for pipe joints.
5. Size: Use pipe sized units
6. Application: Steel piping three (3) inch and smaller.

C. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
2. Maximum Compression: 15/16 inch.
3. Maximum Extension: 5/16 inch.
4. Maximum Offset: 1/8 inch.
5. Joint: Flanged
6. Size: Use pipe sized units
7. Accessories: Internal flow liner.
8. Application: Steel piping three (3) inch and larger.

D. Double Sphere, Flexible Compensators:

1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
2. Working Pressure: 215 psi
3. Maximum Temperature: 250 degrees Fahrenheit.
4. Maximum Compression: 1-1/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
5. Maximum Elongation: 3/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 5/8 inch for 14 inch.
6. Maximum Offset: 3/8 inch through 6-inch pipe; 7/8-inch 8 inch through 12 inch; 1 inch for 14 inch.
7. Maximum Angular Movement: 15 degrees.
8. Joint: Steel flanges or ductile iron pipe flanges.
9. Size: Use pipe sized units
10. Accessories: Control rods.
11. Application: Steel piping two (2) inch and larger.

2.2 ACCESSORIES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Amber / Booth

2. Triplex
3. Mason Industries

B. Pipe Alignment Guides: Two-piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1-inch-thick insulation, minimum 3-inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Work in accordance with ASME B31.9.

B. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.

C. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.

D. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.

E. Provide expansion loops as indicated on Drawings.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pressure gages.
2. Pressure gage taps.
3. Stem type thermometers.
4. Dial thermometer.
5. Thermometer supports.
6. Test plugs.
7. Bladder-type expansion tanks.
8. Air vents.
9. Combination Dir and Air Separators.
10. Strainers.
11. Flow controls / Balancing Valves.
12. Relief valves.
13. Buffer Tanks

B. Related Sections:

1. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: Submit for manufactured products and assemblies used in this Project.

1. Manufacturer’s data and list indicating use, operating range, total range, accuracy, and location for manufactured components.

2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.

3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.

4. Submit electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and instrumentation.

B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.8 WARRANTY

A. Furnish one (1) year manufacturer warranty for piping specialties.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Weiss
2. Marsh Bellofram
3. Weksler
4. Dwyer

B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Stainless steel.
2. Bourdon Tube: Phosphor bronze.
3. Dial Size: 4-1/2 diameter.
4. Mid-Scale Accuracy: One (1) percent.
5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Weiss
2. Marsh Bellofram
3. Weksler
4. Pete's Plug
5. Schrader

B. Needle Valve: Brass, 1/4-inch NPT for minimum 300 psi.

C. Ball Valve: Brass 1/4-inch NPT for 250 psi.

D. Pulsation Damper: Pressure snubber, brass with 1/4-inch NPT connections.

E. Siphon: Brass, 1/4-inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Trerice
2. Weiss

B. Thermometer: Rigid 90°F angle, blue colored, organic, mercury fill, Valox case, brass stem, ½ NPT brass thermowell, acrylic window, lens front, magnifying tube type, scale face of aluminum, white background with black graduations and markings

1. Scale Size: 5-1/2" long.
2. Molded Valox - V-shaped black case.
3. Window: Double Strength Glass
4. Stem: Brass, 1/2-inch NPT, and 2 inches long.
5. Accuracy: ±2% of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.4 DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Trerice
2. Weiss

B. Thermometer: 300 stainless steel, hermetically sealed, bimetallic, silicone dampened on ranges to 300°F coil, adjustable angle, ½ NPT, double strength glass window, balanced, black finish pointer, dial face of aluminum, white background with black and blue graduations and markings.

1. Dial Size: 5-inch diameter dial.
2. Window: Double strength glass.
3. Stem: 300 Stainless Steel, ¼" diameter NPT, 2-1/2" long.
4. Length of Capillary: Minimum five (5) feet.
5. Accuracy: ±1% of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.5 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.

B. Flange: Three (3) inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Pete's Plug

B. 1/4-inch NPT or 1/2-inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F.

C. Test Kit:

1. Carrying case, internally padded and fitted containing:

a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
b. Two gage adapters with 1/8-inch probes.
c. Two 1-1/2-inch dial thermometers.

2.7 BLADDER-TYPE EXPANSION TANKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Wheatly
2. Bell and Gossett
3. Wessels
4. Armstrong

B. Tank: Welded steel, rated for maximum 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed

and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Size: As indicated on Drawings.

C. Bladder: Heavy duty butyl-FDA approved.

D. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24 inches length, long enough to cover tank for two (2) inches above bottom to two (2) inches below top.

E. Quick Connect Air Inlet:

1. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

F. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.

G. Hot Water Heating System:

1. Select expansion tank pressure relief valve at 20 psi maximum.
2. Set pressure reduction valve at select 12 psi.

H. Chilled Water System:

1. Select expansion tank pressure relief valve at 25 psi maximum.
2. Set pressure reduction valve at 12 psi.

I. Do not insulate ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

2.8 AIR VENTS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Armstrong
2. ITT
3. Sarco

B. Manual Type: Short vertical sections of two (2) inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.

C. Float Type:

1. Brass, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:

1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.9 COMBINATION DIRT AND AIR SEPARATORS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. Armstrong
3. Wessels
4. Thrush

B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.

C. Dirt & Air Separator: Each separator must be designed with a blow-down valve, skim valve, and automatic air vent. The separator must also utilize in its design a stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure.

2.10 STRAINERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. Keckley
3. Armstrong
4. Mueller

B. Size two (2) inch and Smaller:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.

C. Size 2-1/2 inch to four (4) inch:

1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.

D. Size five (5) inch and Larger:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.11 FLOW CONTROLS / BALANCING VALVES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. Nibco
3. ITT Hoffman

B. Construction: Ametal® Brass or bronze body, y-pattern, with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain.

C. Calibration: Factory set to control flow within five (5) percent of design flow over entire operating pressure.

D. Control Mechanism: Stainless steel or nickel-plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.12 RELIEF VALVES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. McDonnell-Miller

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.13 BUFFER TANKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Chemline
2. Wessels
3. Wendland
4. American Wheatley

B. Internal baffle to insure water mixing, ASME pressure rated to 125 psi at 400 degrees F, welded design, provide air vent and drain. Provide with tank supports for vertical installation. Gallon capacity as indicated on drawings. Select diameter as required to maintain an overall installed height less than or equal to the Architectural screen wall (where a screen wall is shown on Architectural drawings).

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump, pipe to gage.

B. Install gage taps in piping with isolation valves.

C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

G. Locate duct-mounted thermometers minimum ten (10) feet downstream of mixing-dampers, coils, or other devices causing air turbulence.

H. Coil and conceal excess capillary on remote element instruments.

I. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.

J. Provide instruments with scale ranges selected according to service with largest appropriate scale.

K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

L. Adjust gages and thermometers to final angle, clean windows, and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Locate test plugs adjacent to pressure gages and pressure gage taps and as indicated on Drawings.

B. Install manual air vents at system high points.

C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank.

E. Provide drain and hose connection with valve on strainer blow down connection.

F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

H. Support pump fittings with floor mounted pipe and flange supports.

I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

J. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Equipment relief valve capacity not to exceed rating of connected equipment.

K. Pipe relief valve outlet to nearest floor drain.

L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

M. Insulate all volume tanks to match adjacent intake and discharge piping and jacketing requirements.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Globe valves.
2. Ball valves.
3. Plug valves.
4. Butterfly valves.
5. Swing check valves.
6. Spring loaded check valves.
7. Flanges and unions.

1.3 SUBMITTALS

A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.

B. Welders Certificate: Include welder’s certification of compliance with ASME Section IX.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install valves underground when bedding is wet or frozen.

1.8 WARRANTY

A. Furnish one (1) year manufacturer warranty for valves.

1.9 EXTRA MATERIALS

A. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING VALVES

A. Globe Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Milwaukee Valve

2. Two (2) inches and Smaller: Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw, renewable plug disc and stainless-steel seat ring, solder or threaded ends.

3. Two (2) inches and Larger: Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

B. Ball Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Belimo
   d. Milwaukee Valve

2. Two (2) inches and Smaller: Bronze two-piece body, full port stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends with union.

3. Two (2) inches and Larger: Carbon steel body, stainless steel ball and stem, Teflon seat and stuffing box seals, lever handle, or gear drive hand-wheel for sizes ten (I0) inches and larger, flanged.

4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive material. Also provide a protective sleeve to prevent damage to vapor seal when valve adjustment is made. Memory stops shall be adjustable after insulation is applied.

C. Plug Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
   a. Nibco
   b. Crane

2. Two (2) inches and Smaller: Bronze body, bronze tapered plug, full port opening, non-lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

3. Two (2) inches and Larger: Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, flanged ends. Furnish each plug valve with wrench with setscrew.

D. Butterfly Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Dezurik
   d. Haleson
   e. Milwaukee Valve

2. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.

3. Disc: Aluminum bronze.

4. Operator: 10 position lever handle on sizes two and half (2 1/2) inches to four (4) inches.

5. Hand-wheel and gear drive on sizes larger than six (6) inches.

E. Swing Check Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Dezurik
   d. Haleson
   e. Milwaukee Valve

2. Two (2) and Smaller: Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder, or threaded ends.

3. Two and a half (2-1/2) inches and Larger: Iron body, bronze trim, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged ends or Ductile iron body, 316 stainless steel clapper, synthetic rubber bumper/seal and bonnet.

F. Spring Loaded Check Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Nibco
   b. Crane
   c. Dezurik
   d. Haleson
   e. Milwaukee Valve

2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

3. Two (2) and Smaller: Red bronze body, 301 stainless steel spring-actuated disc, EPDM o-ring, 300 series stainless steel stem and spring, in-line, lift-type check valve.

2.2 FLANGES AND UNIONS

A. Unions for Pipe two (2) inches and Smaller:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze soldered or push-to-connect joints.

B. Flanges for Pipe two (2) inches and Larger:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.

C. Gaskets: 1/16-inch-thick preformed neoprene.

D. Accessories: Stainless Steel bolts, nuts, and washers.

E. Dielectric Connections:

1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide non-conducting dielectric connections wherever joining dissimilar metals.

B. Install valves with stems upright or horizontal, not inverted.

C. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment, or other apparatus.

D. Install butterfly or ball shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

E. Install calibrated-orifice, balancing valves at each branch connection to return main.

F. Install globe or ball valves for throttling, bypass, or manual flow control services.

G. Provide spring loaded check valves on discharge of water pumps.

H. Provide flow controls in water re-circulating systems.

I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

J. Use 1 1/4” inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

K. Install valves in accessible locations to permit removal of bonnet.

L. Install valve stems in vertical position. Valve stems installed in horizontal position shall be no less than 30 degrees from horizontal.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment roof curbs and support rails.
6. Sleeves.
7. Mechanical link seals.
8. Formed steel channel and angle.
9. Equipment bases and supports.
10. Portable roof pipe supports.

B. Related Sections:

1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Carpenter & Paterson Inc.
2. Flex-Weld, Inc.
3. Globe Pipe Hanger Products Inc.
4. Michigan Hanger Co.
5. B-Line Systems
6. Carpenter & Patterson Inc.
7. Anvil International
8. Piping Technology & Products
9. Grinnell

B. Hydronic Piping:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.

3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.

5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.

6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.

7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.

8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.

9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.

10. Vertical Support: galvanized Steel riser clamp.

11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

14. Copper Pipe Support: Copper-plated, carbon steel ring.

15. Hydronic Piping shall not have support brackets welded to hydronic piping.

C. Roof Mounted Hydronic Piping:

1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 HOODED CURB

A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.

B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12” high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.

C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12” high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.

D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. The Pate Co.
   b. Custom Curb, Inc.
   c. Roof Products, Inc.

E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.7 SLEEVES

A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel.

E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.8 MECHANICAL LINK SEALS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Thunderline Link-Seal / GPT.
2. Innerlynx.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL AND ANGLE

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division
4. Unistrut Corp.

B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.

C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.

D. Structural members to be loaded within manufacturers design limitations and published data.

2.10 EQUIPMENT BASES AND SUPPORTS

A. In accordance with Division 3 – Concrete

B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:

1. Hot Water Boilers: four (4) inches.
2. Floor Mounted Pumps: four (4) inches.
3. Floor Mounted Water Volume Tanks: four (4) inches.
4. Air Handling Units: six (6) inches.
5. Water Heaters: four (4) inches.
6. Water Softeners: four (4) inches.
7. Air Compressor: four (4) inches.
8. Floor Mounted Expansion Tanks: four (4) inches.
9. Floor Mounted chemical feeder tanks: four (4) inches.
10. Floor Mounted Fans: four (4) inches.
11. Chillers: four (4) inches.
12. Condensing Units: four (4) inches.
13. Heat Pump Units: six (6) inches.
14. Dust Collectors: four (4) inches.
15. Plasma cutters: four (4) inches.

C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.11 PORTABLE ROOF PIPE SUPPORTS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Advanced Support Products (ASP)
2. PHP System Design

B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be provided with height adjustable crossbar and clevis hangers. Product specifications:

1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.

2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.

3. Height: Adjustable.

4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.

5. Hardware: Corner brackets and leg brackets bolted with ½" x 2-1/2" bolt & ½" nut; frame bolted to support base with ½" x 2-1/2" bolts, ½" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.

6. Required accessories: ½" threaded rod, clevis hangers, strut clamps and protection pads.

C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:

1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.

2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.

3. Hardware: ½" threaded rods (12" high); ½" nuts & washers, hot- dipped galvanized.

4. Height: Adjustable.

5. Required accessories: Strut clamps and protection pads.

6. Hot dipped galvanized threaded rods, nuts, and washers.

D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.

1. Material: Porous rubber.
2. Weight: 2 lbs.
3. Dimensions: 18” square X ½” thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.

B. Remove incompatible materials affecting bond.

C. Install damming materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2-inch minimum vertical adjustment.

F. Support vertical piping at every other floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports.

L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach

Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.

E. Extend sleeves through walls two (2) inches each side.

F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.

B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Fire Rated Surface:

1. Seal opening at floor, wall, and partition as follows:

a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.

b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.

c. Pack void with backing material.

d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

F. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall and partition floor as follows:

a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.

b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.

2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.

B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.

C. Access Doors:

1. Plastic Surfaces: Milcor Style K.
2. Ceramic Tile Surface: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

A. Verify that roof surface is smooth and clean to extent needed to receive material.

B. Clean surfaces to receive 17” circular bases removing any loose gravel and foreign matter before setting 17” circular bases.

C. Provide protective pad conforming to the new or existing roof manufacturer’s system under each 17” circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

A. Minimum hanger rod size shall be ½".

B. Maximum hanger rod spacing shall not exceed 10'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.

C. For trapeze supports provide a minimum of (2) two ½" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.

D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Vibration isolation for building mechanical systems.

B. Related Sections:

1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Mason Industries model numbers are listed for identification only.

D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Mason Industries
2. Kinetics Noise Control
3. Amber / Booth
4. VMC
5. Vibration Eliminator
6. Vibro-Acoustics

1.3 PERFORMANCE REQUIREMENTS

A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.

B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.

C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.

D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.

E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.

F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.

H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.

I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.

J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.

K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.

L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.

M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.

1. Offices
   Executive: 30
   Conference rooms: 30
   Private: 35
   Open-plan areas: 35
   Computer/business machine areas: 40
   Public circulation: 40

2. Schools
   Lecture and classrooms: 30
   Open-plan classrooms: 35

3. Libraries: 25

4. Theaters
   Theater: 25
   Stage house: 25
   Trap room: 25
   Orchestra pit: 25

Rehearsal rooms: 25
Teaching studios: 30
Practice rooms: 30
Ensemble rooms: 30
Shop: 45

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.5 QUALITY ASSURANCE

A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.

C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.

E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.

F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.

G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete

and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.

C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where

space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2 inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS (CHILLERS AND BASE-MOUNTED PUMPS)

A. Type SFDEJ, SFEJ, SFDCR or SFU with Control Rods CR (required): Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14"shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14"shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2"thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

B. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1” inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.

B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch

minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.

B. Locate isolation hangers as near the overhead support structure as possible.

C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.

E. Install Work in accordance with ASME B31.9.

F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.

G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (Inches)	BASE (1) TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (Inches)	BASE (1) TYPE

AIR HANDLING UNITS (NOTE 2)						
FLOOR MOUNTED	SLF	0.75	-	SLF	0.75	-
TO 15 HP	SLF	1.5	-	SLF	0.75	-
20 HP & OVER						
SUSPENDED	30N	1	-	30N	1	-
UP TO 15 HP	PC30N	1.75	-	PC30N	1	-
20 HP & OVER						
HIGH PRESSURE FAN	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
SECTION (NOTE 1)	BI	2.5	RBMK	BI	1.5	RBMK
UP TO 30 HP	SLF/W			SLF/W		
40 HP & OVER	BI			BI		
CENTRIFUGAL FANS						
CL. I & II UP TO 54-1/2" W.D.						
Up to 15 HP	SLF	0.75	WF	SLF	0.75	WF
20-50 HP	SLF	1.5	RBMK	SLF	0.75	WF
60 HP & OVER	SLF	2.5	RBMK	SLF	1.5	WF
CL. I & II 60" W.D. & OVER/ALL						
CL. III FANS UP TO 15 HP	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
20-50 HP	BI	2.5	RBMK	BI	1.5	RBMK
60 HP & OVER	SLF/W	2.5	RBMK	SLF/W	1.5	RBMK
	BI			BI		
	SLF/W			SLF/W		
	BI			BI		
AXIAL-FLOW FANS (NOTE 1)						
FLOOR MTD.						
UP TO 15 HP	SLF	0.75	-	SLF	0.75	-
20 HP & OVER	SLF	1.5	-	SLF	0.75	-
SUSPENDED (NOTE 1)						
UP TO 15 HO	30N	1	-	30N	1	-
20 HP & OVER	PC30N	1.75	WF	PC30N	1.5	-
VENT (UTILITY SETS)						
FLOOR MTD.	SLF	0.75	-	SLF	0.75	-
SUSPENDED	30N	1	-	30N	0.75	-
CABINET FANS, FAN SECTIONS (NOTE 1)						
CL. I & II UP TO 54-1/2" W.D.	SLF	0.75	-	SLF	0.75	-
Up to 15 HP	SLF	1.5	-	SLF	0.75	-
20-50 HP						
SUSPENDED	30N	1	-	30N	0.75	-
UP TO 15 HP	PC30N	1.75	-	30N	1.75	-
20 HP & OVER						
PUMPS						
FLOOR MTD. UP TO 60 HP	SLF	1.50	RBMK	SLF	0.75	RBMK
FLOOR MTD. 75 HP AND LARGER	SLF	2.50	RBMK	SLF	0.75	RBMK
	PC30N	1.75	-	PC30N	1.75	-
SUSPENDED INLINE						
REFRIGERATION UNITS						
RECIPROCATING	SLF	1.5	RBMK	SLF	0.75	RBMK
COMPRSSORS	SLR/IC	1.5	-	SLF	0.75	-
RECIPROCATING COND.	S	1.5	-	WSW	0.15	-
UNITS & CHILLERS	SLR	1.5	RBMK	WSW	0.15	-

HERMETIC CENTRIFUGALS OPEN CENTRIFUGALS ABSORPTION MACHINES	SLF SLR/ICS	0.75	-	WSW	0.15	-
AIR COMPRESSORS TANK TYPE (HORIZONTAL TANK) TANK TYPE (VERTICAL TANK)	 SLF SLF	 1.5 1.5	 - -	 SLF SLF	 0.75 0.75	 - -
COOLING TOWERS & CLOSED-CIRCUIT COOLERS UP TO 500 TONS OVER 500 TONS	SLR SLR	0.75 2.5	(1) (1)	WSW WSW	0.15 0.15	- -
AIR COOLED CONDENSERS UP TO 50 TONS OVER 50 TONS	 SLR SLR	 0.75 1.5	 (1) (1)	 WSW WSW	 0.15 0.15	 - -
ROOFTOP AIR CONDITIONING UNITS REQUIRING WEATHER SEAL UP TO 5000 CFM (12 TON) OVER 5000 CFM (12 TON) OTHER TYPES UP TO 25 TONS OVER 25 TONS	 SLF SLR SLR SLR	 0.75 1.5 1.5 1.5	 RSC/C MAB RSC/C MAB (1) (1)	 - - - -	 - - - -	 - - - -
BOILER (PACKAGE TYPE) ALL SIZES	 SLR	 0.75		 WSW	 0.15	 -
ENGINE DRIVEN GENERATORS UP TO 60 HP 75 HO & OVER	SLR SLR	1.5 2.5	RBMK RBMK	SLR SLR	0.75 0.75	- -

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.

2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.
8. Pipe painting (if required)

B. Related Sections:

1. Section 09 91 00 - Painting and Staining.

C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. District Standards for identification and color scheme.

1.4 SUBMITTALS

A. Product Data: Submit manufacturers catalog literature for each product required.

B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

B. Conform to ANSI / OSHA Pipe Marking Specifications.

C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.

B. Metal Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

C. Information Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Stencils: With clean cut symbols and letters of following size:

1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.

2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.

3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.

4. Ductwork and Equipment: 1-3/4 inches high letters.

C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

B. Plastic Tape Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

C. Plastic Underground Pipe Markers:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

   a. Craftmark Identification Systems.
   b. Safety Sign Co.
   c. Seton Identification Products.
   d. Almetek Industries.
   e. Marking Services, INC. (MSI).
   f. Brimar.

2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.

2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Almetek Industries.
e. Marking Services, INC. (MSI).
f. Brimar.

2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Almetek Industries.
e. Marking Services, INC. (MSI).
f. Brimar.

2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.

F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.

G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.

H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

I. Identify control panels and major control components outside panels with plastic nameplates.

J. Identify air terminal units and radiator valves with numbered tags.

K. Tag automatic controls, instruments, and relays. Key to control schematic.

L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.

N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Heating Water	Green	Heating Water Supply Heating Water Return
Refrigerant Piping	Purple	Refrigerant Liquid Refrigerant Suction
Domestic Water (cold)	Blue	Domestic Water
Domestic Hot Water Supply	Red	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply Condenser Water Return

B. PIPE PAINTING:

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.

2. The entire fire protection piping system shall be painted red.

3. All outdoor un-insulated piping shall be painted with primer as a minimum.

4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Blue
Domestic Hot Water Supply and Return	Red
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Green
Heating Hot Water supply and Return	Green

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Testing, adjusting, and balancing of Hydronic piping systems
3. Testing, adjusting, and balancing of refrigerating systems.
4. Measurement of final operating condition of HVAC systems.
5. Sound measurement of equipment operating conditions.
6. Vibration measurement of equipment operating conditions.

B. Related Sections:

1. Sequences of operation for HVAC equipment as scheduled on Drawings.

C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.

D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.

E. TAB Contractors:

1. Engineered Air Balance
2. Precision Air

1.3 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

C. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

D. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.

E. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of hoe the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.

2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.

    a. General Information and Summary
    b. Air Systems
    c. Refrigerant Systems
    d. Temperature Control Systems
    e. Special Systems.

4. Report Contents: Provide the following minimum information, forms and data:

a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.

B. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.

2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.

C. Codes and Standards

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. AABC: "National Standards for Total System Balance."

3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.

D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.

C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.

B. Examine the approved submittals for HVAC systems and equipment.

C. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed, and duct end caps are in place.

10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.
16. Re-sheave

D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.

E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.

F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.

G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

C. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%

2. Air Outlets and Inlets: +/- 5%

3. Heating-Water Flow Rate: +/- 5%

4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

   b. Measure static pressure directly at the fan outlet or through the flexible connection.

   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.

B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

1. If insufficient static pressure exists, increase airflow at the fan.

C. Test and adjust the constant-volume mixing boxes as follows:

1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.

2. Verify sufficient inlet static pressure before making volume adjustments.

3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.

D. Do not over pressurize ducts.

E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.

7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

A. Set unit at maximum airflow through the cooling coil.

B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.

2. Check liquid level in expansion tank.

3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated pre-settings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.

B. Preparation of the hot water system for balancing:

1. Confirm outlet temperature of the system at water heaters and/or storage tanks.

2. Verify recirculation pump operation and rotation.

3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.

C. The test and balance report shall indicate the following:

1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.

2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.

5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.

2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.

3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.

4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.

5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.

6. Capacity: Calculate in tons of cooling.

7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.

2. Measure motor voltage and amperage. Compare the values to motor nameplate information.

3. Check the refrigerant charge.

4. Check the condition of filters.

5. Check the condition of coils.

6. Check the operation of the drain pan and condensate-drain trap.

7. Check bearings and other lubricated parts for proper lubrication.

8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

4. Balance each air outlet.

3.22 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.

e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).

i. Outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:
1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h (kW).
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.

l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h (kW).
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h (kW).
b. Air flow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig (Pa).

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.

f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.

p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

N. Vibration Test:

1. Location of points:

a. Fan bearing, drive end
b. Fan bearing, opposite end
c. Motor bearing, center (when applicable)
d. Motor bearing, drive end
e. Motor bearing, opposite end
f. Casing (bottom or top)
g. Casing (side)
h. Duct after flexible connection (discharge)
i. Duct after flexible connection (suction)

2. Test readings:

a. Horizontal, velocity and displacement
b. Vertical, velocity and displacement
c. Axial, velocity and displacement
d. Normally acceptable readings, velocity and acceleration
e. Unusual conditions at time of test
f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.

B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:

C.

1. NFPA 90A.
2. NFPA 90B.
3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
4. ASTM C1136: 150 degrees F.
5. ASTM C1290.
6. UL 181 for Class I Air Duct.
7. NAIMA AHS-152T.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work

C. Submit manufacturer's product data and installation instructions.

D. Provide drawings indicating typical duct insulation details, thickness and location. Identify areas and required insulation.

E. Manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.

C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.6 DELIVERY, STORAGE & HANDLING

A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.

B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:

A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Owens Corning
2. Johns Manville
3. CertainTeed
4. Knauf brand Insulation

B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Foster
3. Vimasco

C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass
2. Alpha Glass
3. Childers
4. Vimasco

D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of the following:

1. 3M Fire Barrier Duct Wrap
2. Vesuvius Pyroscat Duct Wrap
3. Unifrax Corporation

2.2 DUCT WRAP

A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.

B. Density: 0.75 pounds per cubic foot.

C. Installed minimum R value: 8.3.

D. Nominal Thickness: 3.0 inches.

E. Installed Thickness: 2-1/4 inches.

F. Installed Thermal Conductivity (compressed): k = 0.27

G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.

H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.

I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.

J. Testing Method 1338: Fungi Resistance Comply with requirements.

K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.

L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.

A. Density: 1.5 pounds per cubic foot.

B. Installed minimum R value: 6.3.

C. Thickness: 1-1/2 inches.

D. Thermal Conductivity k, (ASTM C518): 0.24

E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies (Hz)

Freq. (Hz)	125	250	500	1K	2K	4K	NRC
TL (dB)	0.19	0.55	0.84	1.0	1.0	.98	.85

F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.

G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.

H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.

I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.

J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.

K. Bacteria Resistance (ASTM G22): Comply with requirements.

L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.

M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

2.4 ACCESSORIES

A. Heat-Activated Tapes:

1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.

2. Size: At least three (3) inches wide.

B. Mastic and Glass Fabric System:

1. Material Standard: Listed and labeled under UL 181A, Part III.
2. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. **ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:**

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.

2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.

3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:

a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:

1. From transverse end of liner: three (3) inches.
2. Across width of duct: 12 inches on center.
3. From corners of duct: four (4) inches.
4. Along length of duct: 18 inches on center.

b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:

1. From transverse end of liner: three (3) inches.
2. Across width of duct: six (6) inches on center.
3. From corners of duct: four (4) inches.
4. Along length of duct: 16 inches on center.

4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.

5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.

6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.

7. If the specification requires use of multiple insulation layers, take the following additional steps:

a. Affix bottom layer of duct liner in normal manner.

b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.

c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.

d. Use mechanical fasteners of the proper length for the double layer.

8. Application: Provide duct liner as follows:

a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
b. Provide duct liner in all return air boots and transfer ducts.
c. Provide duct liner in the first 15 feet of supply and return duct from roof mounted air handling units / roof top units.

B. **THERMAL INSUALTION WRAP ON DUCT AND FITTINGS:**

1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.

2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.

3. To ensure installed thermal performance, duct wrap insulation shall be cut to “stretch-out” dimensions as shown in tables in manufacturer’s literature.

4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.

5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.

6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.

7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.

8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.

9. Application: Provide duct wrap as follows:

   a. All supply duct

   b. All outside air supply and intake duct

   c. All return air duct

   d. All return air plenums on air units

   e. All intake plenums on outside air handling units

   f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. **INTERIOR EXPOSED DUCT**

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 1-1/2, 1.5 pcf (installed R-Value of 6.0) on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.

2. Round duct to be galvanized spiral lock seam type.

3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.

4. Application: Provide double wall duct as follows:

a. Gymnasiums
b. Natatoriums
c. Return air plenums with ducted connection to return grilles
d. Ducted connections to return air grilles
e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.

B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

A. Supply and return ducts routed indoors (Ambient temperature $\leq$ 85 degrees Fahrenheit, RH $\leq$ 70 percent): R-8.3 (minimum).

B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature $\leq$ 95 degrees Fahrenheit, RH $\leq$ 70 percent): R-8.3 (minimum).

C. Supply, return and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).

D. R-values represent installed values.

E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section Includes:

1. Chilled Water Components
2. Heating Hot Water Components

1.2 SYSTEM DESCRIPTION

A. Provide equipment insulation systems that have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.

B. Performance Requirements: Provide equipment insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:

1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work

C. Submit manufacturer’s product data and installation instructions.

D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.

E. Manufacturer’s certificate that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Utilize an installer who has demonstrated five (5) years experience on projects of similar size and complexity.

B. Condensation on any insulated system is not acceptable. Replace insulation damaged by condensation.

C. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

D. Certifications: Manufacturer certification that products supplied meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.

B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Johns Manville
2. Owens-Corning
3. Knauf
4. Certainteed

B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Pittsburg Corning
2. Cell-U-Form

C. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass Mesh
2. Alpha Glass Mesh
3. Childers Chil-Glas
4. Vimasco
5. RPR Products Inc.

D. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Foster
3. Vimasco

2.2 EQUIPMENT INSULATION

A. Glass Fiber Insulation Boards:

1. Thickness: Same thickness as connected piping.

2. Equipment Operating Temperature Limit (ASTM C411): Up to 450 degrees Fahrenheit.

3. Insulation Jacket Temperature Limit (ASTM C1136): -20 - 150 degrees Fahrenheit.

4. Vapor Retarder: ASJ vapor retarder facing.

5. Jacket Permeance (ASTM E96): 0.02 perm.

6. Jacket Puncture Resistance (ASTM D781): ASJ: 50 units.

7. Water Vapor Sorption (ASTM C1104): <2pecent by weight at 120 degrees Fahrenheit.

8. Density: Same as adjoining pipe insulation.

9. Composition Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25, smoke developed 50.

B. Equipment and Tank Insulation:

1. Description: Flexible pipe and tank insulation made of semi-rigid fibrous glass board material with a laminated Kraft-aluminum foil ASJ facing.

2. Operating Temperature (ASTM C411): 0 - 650 degrees Fahrenheit.

3. Length: 36 inches.

4. Size: 1-1/2 inches.

5. Material Standard: Comply with ASTM C1393, Type II.

6. Material Standard: Comply with ASTM C795.

7. Material Standard: Comply with ASTM C1136, Type II.

8. Material Standard: Comply with NRC Guide 1.36.

9. Jacket Temperature Limitation (ASTM C1136): -20 - 50 degrees Fahrenheit.

10. Jacket Permeance (ASTM E961): 0.02 perm.

11. Puncture Resistance (ASTM D781): 50 units.

12. Compressive Strength at 10 % Deformation (ASTM C165): 125 psf.

2.3 CELLULAR GLASS INSULATION

A. Rigid factory fabricated closed-cell equipment insulation:

1. Thermal conductivity "k" of btuh-in / hr-sq.ft. degree F at 75-degree mean temperature.

2. Density shall be an average of 8 lb./cu.ft.

3. Compressive strength of 100 psi.

2.4 ALUMINUM JACKET

A. Jacket for equipment and tanks shall be 0.16-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.

B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering. Fitting covers shall be manufactured to ASTM C-450 standards.

PART 3 - EXECUTION

3.1 GENERAL

A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breeching, or stacks while hot.

E. Apply insulation using staggered joint method for both single- and double-layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least two (2) inches. Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

3.2 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the equipment insulation manufacturer.

3.3 EXAMINATION

A. Site Verification of Conditions:

B. Verify that site conditions are acceptable for installation of equipment insulation.

C. Do not proceed with installation of equipment insulation until unacceptable conditions are corrected.

3.4 INDOOR CHILLED WATER PUMPS

A. Shall be insulated with rigid insulation board, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide x .020 galvanized bands spaced on nine (9) inch centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of vapor barrier mastic, a layer of one (1) inch mesh galvanized wire, and a coat of cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place.

B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

3.5 OUTDOOR CHILLED WATER PUMPS

A. Shall be insulated with cellular glass insulation, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide aluminum bands spaced on nine (9) inch centers. Bands shall be pulled snug over insulation. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. Provide aluminum jacket over insulation.

3.6 ALUMINUM JACKET

A. Install insulating materials per manufacturer’s recommendations.

B. Install aluminum jacketing per manufacturer’s recommendations.

C. Apply aluminum jacketing by lapping, sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.

D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.

E. Lap joints against weather so that water will run off lower edge.

F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.

G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.

H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.

I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.

J. Equipment exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

3.7 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATED WITH FIBERGLASS

A. Location: Indoor, conditioned spaces

B. Support Inserts: At each support point, install a hard section of cellular glass on lower 180 degrees of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Seal and finish to match the adjoining insulation. Provide formed 16 ga. galvanized sheet-metal saddles.

C. Installation: All equipment must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide three (3) inch butt strips at each joint between sections and seal with adhesive.

3.8 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATE WITH CELLULAR GLASS

A. Location: Outdoor, un-conditioned spaces and ventilated spaces

B. The insulation shall be applied to equipment with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.

C. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.

D. Metal jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.

E. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

3.9 INSULATION SCHEDULE

A. Chilled water components located within condition spaces.

1. Insulation thickness: Match adjoining piping thickness.

B. Chilled water components located in un-conditioned or ventilated spaces and outdoors

1. Insulation thickness: Match adjoining piping thickness.

3.10 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Pipe Insulation

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.

B. Performance Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:

1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.

C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

b. Detail attachment and covering of heat tracing inside insulation.

c. Detail insulation application at pipe expansion joints for each type of insulation.

d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

e. Detail removable insulation at piping specialties.

f. Detail application of field-applied jackets.

g. Detail application at linkages of control devices.

1.5 QUALITY ASSURANCE

A. Installation Qualifications: Utilize an installer having demonstrated (5) five years experience on projects of similar size and complexity.

B. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.

C. All materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84):

1. Flamespread: 25

2. Smoke developed: 50

D. All materials shall have U.L. label.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver insulation materials in manufacturer’s original, unopened, undamaged containers with identification labels intact

B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Johns Manville
2. Owens Corning
3. Knauf

4. Certainteed

B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Pittsburg Corning
2. Cell-U-Foam

C. Phenolic Foam Insulation: Subject to compliance with plans and specification, provide one of the following:

1. Resolco
2. Koolphen® K

D. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Pabco
3. RPR

E. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:

1. Perma Glass Mesh
2. Alpha Glass Mesh
3. Childers Chil-Glas
4. Vimasco

F. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:

1. Childers
2. Foster
3. Vimasco

2.2 FIBERGLASS PIPE INSULATION

A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.

1. Thermal conductivity “k” of 0.23 of Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
2. Maximum jacket permeance shall be 0.02.

2.3 CELLULAR GLASS INSULATION

A. Rigid factory fabricated closed-cell pipe insulation:

1. Thermal conductivity “k” of 0.32 Btuh-in / hr-sq.ft. °F at 75-degree mean temperature.
2. Density shall be an average of 8 lb/cu.ft.
3. Maximum jacket permeance shall be 0.02.
4. Compressive strength of 100 psi.

2.4 PHENOLIC FOAM INSULATION

A. Rigid factory molded phenolic foam insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.

1. Thermal conductivity “k” of 0.18 btu-in / hr-sq.ft. °F at 75°-degree mean temperature.
2. Maximum jacket permeance shall be 0.02.
3. Compressive strength of 24 psi

2.5 ALUMINUM JACKET

A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.

B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 -EXECUTION

3.1 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer’s recommendations.

3.2 PREPARATION

A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. Install all insulation materials and accessories in accordance with manufacturer’s published instructions and recognized industry practices to ensure that it will serve its intended purpose.

B. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.

E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

F. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

G. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

H. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

I. Apply multiple layers of insulation with longitudinal and end seams staggered.

J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

K. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

L. Keep insulation materials dry during application and finishing.

M. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

N. Apply insulation with the least number of joints practical.

O. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

Q. Apply insulation continuously through hangers and around anchor attachments.

R. For insulation application where vapor retarder is indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

T. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

U. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

V. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

W. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder

4. Vapor-Retarder Mastics: Where vapor retarder is indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings, at penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

5. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

    a. Seal penetrations with vapor-retarder mastic

    b. Apply insulation for exterior applications tightly joined to interior insulation ends.

    c. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.

    d. Seal metal jacket to roof flashing with vapor-retarder mastic.

6. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

7. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

8. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

    a. Fire stopping and fire-resistive joint sealers are specified in Division 7.

9. Floor Penetrations: Apply insulation continuously through floor assembly.

    a. For insulation with vapor retarder, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

X. Insulation Installation of Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.

2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.

3. For insulation with factory-applied jackets without integral vapor retarder, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

Y. Insulation Installation on Pipe Flanges:

1. Apply preformed cellular-glass pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cellular-glass block insulation.

4. Install jacket material with manufacturers recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.

Z. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of molded cellular-glass insulation and match thickness to that of adjoining pipe. Fittings and fabricated segments shall be securely held in place with ½ inch x 0.20-inch type 3105 aluminum bands.

    a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.

    b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

    c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

AA. Insulation Installation on Valves:

1. Install preformed two-piece factory molded cellular-glass insulation to valve body, match adjoining pipe insulation thickness. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application.

    a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.

b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

BB. PVC Cover:

1. Provide factory molded covers for all fittings, elbows and flanges.

3.4 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

a. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.

b. Embed 10 x 10 fiberglass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.

c. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. Apply foil and paper jackets where indicated.

a. Draw jacket material smooth and tight.

b. Apply lap or joint strips with the same material as jacket.

c. Secure jacket to insulation with manufacturer's recommended adhesive.

d. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints. Where vapor retarder is indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder mastic to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.

e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

3.5 CHILLED WATER, HOT WATER, CONDENSATE DRAIN AND MISCELLANEOUS PIPING SYSTEMS

A. Location: Indoor, conditioned spaces - return air plenums, air handling unit rooms

B. Insulation Type:

1. Heating Water and Condensate Piping: **Fiberglass**

2. Chilled Water Piping: **Phenolic Foam**

C. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining

insulation. Cellular glass length shall overhang a minimum of 2" on both sides of the saddle. Refer to 3.5, E for saddle length requirements.

D. Provide formed 16 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, ¾" width and joined with ¾" aluminum wing seals.

E. Provide formed 16 ga. galvanized sheet-metal saddles as follows:

3. Insert and saddle lengths:

a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
b. 3 inch through 6-inch pipe - 12 inches Long
c. 8 inch through 10-inch pipe - 16 inch Long
d. 12 inches and larger pipe - 22 inches Long

F. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide 3-inch butt strips at each joint between sections and seal with adhesive.

G. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.6 CHILLED WATER, HOT WATER, CONDENSATION DRAIN AND MISCELLANEOUS PIPING SYSTEMS

A. Location: Outdoor, un-conditioned spaces (non-return air plenums) and ventilated spaces. Shall include but not limited to: boiler rooms, non-return air plenum mechanical rooms, chiller rooms, and pump rooms.

B. Insulation Type:

1. Condensate Piping: **Fiberglass**

2. Chilled Water and Heating Water Piping: **Phenolic Foam**

C. Cellular Glass Installation:

1. The insulation shall be applied to piping with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.

2. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.

3. Aluminum jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.

4. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

D. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent

compression at support bearing area. Sealed and finished to match the adjoining insulation.

E. Provide formed 14 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, ¾" width and joined with ¾" aluminum wing seals.

F. Provide formed 14 ga. galvanized sheet-metal saddles as follows:

1. Insert and saddle lengths:

a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
b. 3 inch through 6-inch pipe - 12 inches Long
c. 8 inch through 10-inch pipe - 16 inch Long
d. 12 inches and larger pipe - 22 inches Long

G. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive and vapor retarder mastic. Provide 3-inch butt strips at each joint between sections and seal with adhesive.

H. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.7 ALUMINUM JACKET

A. Install insulating materials per manufacturer's recommendations.

B. Install aluminum jacketing per manufacturer's recommendations.

C. Apply aluminum jacketing by lapping and sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.

D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.

E. Lap joints against weather so that water will run off lower edge.

F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.

G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.

H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.

I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.

J. Pipe exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

K. All exterior pipes shall have specified aluminum jacket for protection.

3.8 PROTECTION

A. Replace damaged aluminum jacketing and insulation, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and / or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.9 INSULATION SCHEDULE

A. Chilled water piping located within condition spaces.

1. Insulation thickness **(Phenolic Foam)**:

a. 1-1/2” thick insulation for: ½” through 2” pipe
b. 2” thick insulation for: 2-1/2” and larger pipe

B. Chilled water and hot water piping located in un-conditioned or un-ventilated spaces and outdoors.

1. Insulation thickness **(Phenolic Foam)**:

a. 1-1/2” thick insulation for: ½” through 2” pipe
b. 2” thick insulation for: 2-1/2” and larger pipe

C. Hot water piping located within conditioned spaces

1. Insulation thickness: **(Fiberglass):**

a. 1-1/2” thick insulation for: ½” through 1-1/2” pipe
b. 2” thick insulation for: 2” and larger pipe

D. Cold Condensate Drain Lines

1. Insulation thickness: **(Fiberglass):**

a. 1” thick insulation for all pipe sizes and locations

END OF SECTION 23 07 19

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Section 019114 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.

2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.

4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.

5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.

6. Test and inspection reports and certificates.

7. Corrective action documents.

8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least [10] days in advance of testing and balancing Work and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.

2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Subcontractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R **Subcontractor** shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to

Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.

3. Minimum flushing water velocity.

4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hot-water and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

H. Refer to plans and specifications for HVAC system type.

END OF SECTION 23 08 00

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Heating and cooling piping:

1. Control valves
2. Flow meters
3. Flow switches
4. Press and temp sensor wells & sockets
5. Temp sensor wells and sockets

B. Duct accessories:

1. Airflow stations
2. BAS control dampers
3. Terminal unit controls

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. Communications with Third Party Equipment:

1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section (reference sequence of operations and points list for specifics). Those systems include:

a. Boilers
b. Chillers
c. Cooling Towers
d. Switchgear
e. Variable Speed Drives
f. Computer Room Units (MDF)

EQUIPMENT SHALL BID AS AN ALTERNATE

g. Rooftop Units

1.4 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:

1. Division 01- General

2. Division 23 – Mechanical

3. Division 26 – Electrical

1.5 DESCRIPTION

A. General: The control system shall consist of a complete BAS system with a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphics. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. If individual software seat licenses or keys are required provide a minimum of 4 additional licenses to accommodate multiple owner operators.

B. If manufacture offers a web-based BAS platform, the installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to-peer environment.

C. The system shall directly control HVAC equipment as specified in Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints.

D. Provide a fully direct-digital, native BACnet BAS conforming to the current applicable ASHRAE 135 standard, connected to the District WAN and accessible using an Owner-authorized PC, laptop, tablet, or smartphone. Pneumatic controls are prohibited for new installations.

E. Display available BACnet diagnostic and operating points on the BAS graphics. Chiller start/stop shall be via hardwired control points, not BACnet interface commands. For chillers and boilers, provide/display applicable hardwired start/stop, status, amperage, alarms, and entering/leaving condenser and evaporator or boiler water temperatures. Coordinate hardwired commands with equipment factory controls and approved sequence of operations.

F. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms specified shall be BACnet objects.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.6 APPROVED CONTROL SYSTEMS

A. The following are approved control system suppliers, manufacturers, and product lines:

1. Refer to Specification 01 23 00 Alternates for acceptable manufacturers.

1.7 QUALITY ASSURANCE

B. Installer and Manufacturer Qualifications

1. Installer shall have an established working relationship with Control System Manufacturer for a period of 10 years or greater. If the distributorship has not had duration of more than 10 years, the contractor will not be approved without the written approval prior to bid date (no exceptions).

2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

3. BAS Graphics shall be Three Dimensional Thermographic.

4. BAS provider shall warranty controllers for 5 years.

5. BAS Provider shall provide lifetime training for the lifecycle of the facility to the owner at no additional cost.

1.8 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authority’s codes and ordinances for these plans and specifications. At a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)

2. International Energy Conservation Code (IECC)

3. International Building Code (IBC)

4. Uniform Mechanical Code (UMC)

5. ASHRAE Standard 135-2016: BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.9 SYSTEM PERFORMANCE

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.

3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.

4. Object Command. Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.

5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 seconds.

6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.

7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.

8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 seconds of other workstations.

9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Before testing and balancing begins, furnish written documentation confirming that all BAS hardware, software, programmed points, and installed controls have been functionally checked and field verified.

Table1
Reporting Accuracy

Measured Variable	**Reported Accuracy**
Space Temperature	±2ºF
Ducted Air	±2ºF
Outside Air	±2ºF
Dew Point	±3ºF
Water Temperature	±2ºF
Delta-T	±0.25ºF
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.

EQUIPMENT SHALL BID AS AN ALTERNATE

Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO_2)	±50 ppm

Note 1: 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0-6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space Temperature	±2.0ºF	
Duct Temperature	±3ºF	
Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1-150 psi 0-50 in. w.g. differential

1.10 SUBMITTALS

A. Product Requirements: Provide one electronic copy and 4 hard copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. If requested, provide drawings as AutoCAD 2017 and 4 prints of each drawing on 8.5 x 11 paper and 1 electronic copy of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, **clearly indicate applicable data by highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Direct Digital Control System Hardware

   a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

   b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:

      1. Direct digital controllers (controller panels)

      2. Transducers and transmitters

      3. Sensors (include accuracy data)

      4. Actuators

EQUIPMENT SHALL BID AS AN ALTERNATE

5. Valves
6. Dampers
7. Relays and switches
8. Control panels
9. Power supplies
10. Batteries
11. Operator interface equipment
12. Wiring

c. Wiring diagrams and layouts for each control panel. Show termination numbers.

d. Floor plan schematic diagrams indicating field sensor and controller locations.

e. Riser diagrams showing control network layout, communication protocol, and wire types.

2. Central System Hardware and Software

a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.

b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:

1. Central Processing Unit (CPU) or web server
2. Monitors
3. Keyboards
4. Power supplies
5. Battery backups
6. Interface equipment between CPU or server and control panels
7. Operating System software
8. Operator interface software
9. Color graphic software

EQUIPMENT SHALL BID AS AN ALTERNATE

10. Third-party software

c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems

a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.

c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.

d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.

e. Include current as-built control diagrams and O&M documentation in the BAS system tree / energy-management interface for easy Owner access. Provide laminated equipment-specific wiring/control diagrams inside each control panel.

f. Provide an Owner-coordinated inventory of spare analog and digital BAS components, including quantities and device types.

4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.15 (Control System Demonstration and Acceptance).

B. Schedules

1. Within two months of contract award, provide schedule of work indicating:

a. Intended sequence of work items

b. Start date of each work item

c. Duration of each work item

d. Planned delivery dates for ordered material and equipment and expected lead times

e. Milestones indicating possible restraints on work by other trades or situations

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C. Project Record Documents. Submit 8 copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2017 and 6 prints of each drawing on 8 ½" x 11" paper.

2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of (Control System Demonstration and Acceptance).

3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:

a. As-built versions of submittal product data.

b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

g. Graphic files, programs, and database on magnetic or optical media.

h. List of recommended spare parts with part numbers and suppliers.

i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.

EQUIPMENT SHALL BID AS AN ALTERNATE

k. Licenses, guarantees, and warranty documents for equipment and systems.

l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D. Training Materials: The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructors shall have CEU accreditation for all training courses offered. Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall receive free training for the life of the system.

1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.

2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.

3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.

4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.

5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.

6. Software Troubleshooting - Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.

7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.

8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

1.11 WARRANTY

A. Warrant work as follows:

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Warrant materials for specified control system and peripheral control devices free from defects for a period of **5 years** after certificate of substantial completion. Warrant all labor for a period of **1 year** after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request. Additionally, contractor shall offer 24/7 after-hours support to include alarm monitoring and associated dispatch service.

2. Provide graphic modifications for a period of 3 years from date of substantial completion. This shall include room number and equipment modifications as requested by the owner.

3. Provide telephone support free to the owner for a period of 3 years after substantial completion. This service includes technical support for all BAS equipment and shall include troubleshooting and problem resolution via the telephone or web services. Service shall be available during the hours of 7am to 5pm Monday – Friday.

4. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.

5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor or Owner identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.

6. Exception: Contractor shall not be required to warranty existing devices except those that have been rebuilt or repaired during installation.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics

2. Record drawings

3. Database

4. Application programming code

5. Documentation

EQUIPMENT SHALL BID AS AN ALTERNATE

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2016, BACnet.

B. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.

1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.

2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.

F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable the system to both read and write data.

1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or

binary value software points) from any system controller or from the trend history database.

2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.

3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

2.3 OPERATOR INTERFACE

A. Provide equipment summary graphics for applicable DDB, DF, AHU, chiller, cooling tower, pump, exhaust fan, and FCU systems with global setpoints by equipment type and HOA indication for each applicable item. Use Owner-approved room descriptions and as-built room numbering; enable operator navigation from room/zone to serving air system and upstream heating/cooling plant.

B. Provide manufacturer-current operator graphics reviewed and approved by Owner before implementation. Prior to TAB or Substantial Completion, whichever occurs first, verify graphics work on Owner platform. Display applicable lighting status, time remaining on HVAC/lighting overrides, cooling setpoints, building kW, CO2 and outside-air damper position, MDF room temperatures and high temperature alarms, actual terminal-box discharge CFM and min/max CFM, and discharge air temperature.

C. Provide BAS energy reporting software, Automated Logic MPower or approved equivalent, and display whole-building kW on the summary graphic.

D. Provide read-only remote BAS access to the design engineer and project mechanical contractor for one year following Substantial Completion, subject to District IT security approval.

E. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. Existing manufacturer's BAS web server and workstation can be utilized. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.

2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.

EQUIPMENT SHALL BID AS AN ALTERNATE

3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.

4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

F. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2016, BACnet Annex J.

G. Hardware. If providing a new server, each workstation or web server shall consist of the following:

1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.8. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Sequences of Operation, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server shall be Compaq Rack Mounted Server (or equal) with a minimum of:

   a. Dual Processor Intel Pentium 3.66 GHz processor

   b. 1 GB RAM

   c. 80 GB hard disk providing data at 100 MB/sec

   d. RAID 5 Configuration

   e. 128x CD-ROM drive

   f. Most Current Windows Server Operating System

   g. Serial, parallel, and network communication ports and cables required for proper system operation.

2. If providing a server, the server shall support one or more the following database types:

   a. SQL Server 2012 R2
   b. PostgreSQL
   c. MySQL
   d. MS Access

EQUIPMENT SHALL BID AS AN ALTERNATE

H. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out. System shall require username and password to log in to operator interface.

2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.

3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.

4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.

5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.

6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.

7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.

8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.

9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

I. System Software.

1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.

2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on

EQUIPMENT SHALL BID AS AN ALTERNATE

each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Graphics shall

a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.

b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.

c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.

d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

J. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.

2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.

3. System Configuration. Operators shall be able to configure the system.

4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.

5. Security. System shall require a username and password to view, edit, add, or delete data.

a. Operator Access. Each username and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.

EQUIPMENT SHALL BID AS AN ALTERNATE

b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.

c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).

7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93.Alarms shall be BACnet alarm objects and shall use BACnet alarm services.

8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.

9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.

10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.

11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. The contractor shall configure all physical control points and software control points to accumulate trend data. Analog values shall be configured utilizing time-based intervals and digital values shall be configured for COV. Provide at a minimum of 250 samples per control point. If data can be stored locally at the controller level this information shall be archived at the central server or all BAS workstations.

12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.

13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

14. Standard Reports. Furnish the following standard system reports:

EQUIPMENT SHALL BID AS AN ALTERNATE

a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.

b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.

c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:

1. Alarm History.

2. Trend Data. Operator shall be able to select trends to be logged.

d. Where systems are provided, monitor refrigeration system alarms and CO2 status at the BAS frontend; display DX equipment operational status and alarms. Provide humidity monitoring (read-only) for libraries, fine-arts equipment storage, and computer labs, and humidity control where indicated in gymnasiums and similar large hard-floor spaces. Provide MDF zone-temperature alarming and walk-in cooler/freezer high-temperature alarm notification.

e. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

7. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.

8. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.

9. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.

10. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:

a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If

EQUIPMENT SHALL BID AS AN ALTERNATE

English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."

b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.

e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.

A. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

B. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

11. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

EQUIPMENT SHALL BID AS AN ALTERNATE

2.4 CONTROLLER SOFTWARE

A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.

B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.14.c.3 (Operator Activity).

C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:

1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).

2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.

3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.

D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.

E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).

F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).

G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

H. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93.

I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93.

J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.

K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

L. Energy Calculations.

EQUIPMENT SHALL BID AS AN ALTERNATE

1. System shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.

2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.

3. System shall calculate a fixed-window average. Window interval start shall be defined by utility meter digital input signal to synchronize system's and utility's fixed-window averages.

M. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

N. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.

O. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified.

2.5 CONTROLLERS

A. Provide local HAND/AUTO or HAND/OFF/AUTO capability at appropriate DDC controllers and an equivalent authorized HOA indication/command at BAS graphics. Controller addressing shall be possible on site by rotary selector without requiring a laptop for address assignment; confirm compatibility with approved BAS system. Local controller programming / download requirements shall be coordinated with Owner.

B. Provide a dedicated data drop and independent controller/network interface for the main central plant, separate from the main building control panels; coordinate with District IT/network infrastructure.

C. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance).

D. BACnet.

1. Building Controllers (BCs). Each BC shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in

EQUIPMENT SHALL BID AS AN ALTERNATE

ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.

5. BACnet Communication.

   a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.

   b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.

   c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

   d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

E. Communication.

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.

2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment specified in Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

F. Environment. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.

2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.

G. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

EQUIPMENT SHALL BID AS AN ALTERNATE

H. Serviceability.

1. Controllers shall have diagnostic LEDs for power, communication, and processor.

2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.

3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

I. Memory.

1. Controller memory shall support operating system, database, and programming requirements.

2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

J. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).

K. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.

B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.

D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.

E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.

EQUIPMENT SHALL BID AS AN ALTERNATE

F. Binary Outputs. Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.

H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

I. Pulse-Width Modulation. Control actuators designed for pulse-width modulation with a single binary output that cycle with variable on and off times as determined by the application software. Pulse-width modulation may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.

J. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.7 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

    a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
    b. Line voltage units shall be UL recognized and CSA listed.

B. Power Line Filtering.

1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:

    a. Dielectric strength of 1000 V minimum

    b. Response time of 10 nanoseconds or less

EQUIPMENT SHALL BID AS AN ALTERNATE

c. Transverse mode noise attenuation of 65 dB or greater

d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

A. Motorized Control Dampers.
Provide BAS-operated motorized dampers at all applicable outside-air, return-air intake and relief louvers / hood locations. Outside-air damper / pretreatment operation and building relief shall follow scheduled occupied periods and the project-specific ventilation sequence; coordinate fail positions with life safety and equipment requirements.

1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.

   a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.

   b. Other modulating dampers shall be opposed-blade.

   c. Two-position shutoff dampers shall be parallel or opposed-blade with blade and side seals.

2. Frame. Damper frames shall 13-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.

3. Blades. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades shall be suitable for medium velocity (2000 fpm) performance. Blades shall be not less than 16 gauge.

4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.

5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than (10 cfm per ft ^{2}) at (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of (1500 fpm).

6. Sections. Damper sections shall not exceed 48 in. - 60 in. Each section shall have at least one damper actuator.

7. Linkages. Dampers shall have exposed linkages.

B. Electric Damper and Valve Actuators.
Provide proportional modulating 2-10 Vdc control for modulating valve actuators; floating/three-point control is prohibited. All BAS/DDC actuators shall be Belimo, no substitutions unless Owner issues written direction.

1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).

3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.

4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.

5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 inch -.lb torque capacity shall have a manual crank.

6. Acceptable Manufacturers:

   a. Belimo

C. Control Valves.

1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.

2. Type. Provide two or three-way control valves for two-position or modulating service as shown.

3. Water Valves.

   a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.

   b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.

      1. Two-way: 100% of total system (pump) head.

      2. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

   c. Ports. Valves providing modulating service shall have equal percentage ports.

   d. Sizing.

      1. Two-position service: line size.

      2. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).

EQUIPMENT SHALL BID AS AN ALTERNATE

3. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).

4. Two-way and three-way modulating valve shall be one or two sizes smaller than the pipe size.

e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.

1. Water zone valves: normally closed.

2. Heating coils in air handlers: normally closed.

3. Chilled water control valves: normally open.

4. Other applications: as scheduled or as required by sequences of operation.

f. Acceptable Valve and Actuator Manufacturers:

1. Belimo

D. Binary Temperature Devices.

1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.
Provide both discharge-air and return-air temperature monitoring for applicable CV boxes, DDBs, FCUs, multi-zone unit zones, fan-powered boxes, and single-zone AHUs. For applicable terminal units, display actual discharge CFM and minimum/maximum airflow values on floor-plan graphics.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft ^{2} of duct cross-section.

3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.

4. Space Sensors: Space sensors shall be stainless steel flush plate mounted type. Locate space temperature sensors near room doorways and with associated return-air grilles positioned above where feasible. Install sensors at 84 inches AFF as directed by District standards, using blank-plate sensor style only. Sensors shall be field calibratable. Coordinate temperature measurement bias and accessibility/code requirements with Owner and EOR.

5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%-80%.

2. Duct sensors shall have a sampling chamber.

3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.

4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be thermal dispersion type (IFM U 40100 or approved equal) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Thermal dispersion type switches shall have relay output, wire break output and temperature output.

2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 4 enclosure unless otherwise specified.

H. Provide control-volume and fan-powered terminal-box operation by current transformer/switch. Prove main chiller and boiler pump status by wet differential pressure switch, and AHU/OAHU/FCU airflow status by air differential pressure switch. Exhaust fan operation may be proven using current transmitters. Align monitored proof with the actual controlled device and alarm/sequence requirements.

I. Relays.

1. Control Relays. Control relays shall be plug-in type; UL listed and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed and shall have adjustable time delay. Delay shall be adjustable ±100% from

EQUIPMENT SHALL BID AS AN ALTERNATE

setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

J. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

K. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500-ohm maximum burden.

2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

3. Unit shall be split-core type for clamp-on installation on existing wiring.

L. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.

3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

M. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be ±1% full-scale at 500-ohm maximum burden.

3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

N. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

O. Power Monitors.

Provide and integrate metering/monitoring for main building electrical service and, where applicable, central plant electric, main water, gas, kitchen cold-water, kitchen gas and kitchen electric services. Coordinate metering scope, utility interfaces, and Division 26 responsibilities with Owner.

1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.

2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of ±2% at 1.0 power factor or ±2.5% at 0.5 power factor.

P. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

Q. Pressure Transducers.

1. Transducers shall have linear output signal and field-adjustable zero and span.

2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.

4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

R. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

S. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.

2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.

3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

T. Local Control Panels.

Inside each DDC panel, permanently label every wire termination at each controller and include a laminated control/wiring diagram identifying devices served.

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.

3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 WIRING AND RACEWAYS

A. All DDC conduit shall be blue for positive identification. Support low-voltage control cabling independently above ceilings; do not rest or share support with piping, ducts, equipment, or other trades. Seal all control penetrations through equipment, ductwork and wall/floor assemblies appropriately.

B. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

C. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.

B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.

C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for

changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.

B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

A. Site.

1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).

C. Test and Balance.

1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.

2. Train Test and Balance Contractor to use control system interface tools.

3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.

4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

D. Life Safety.

1. Duct smoke detectors required for air handler shutdown are provided and wired under Division 26.

2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23 and wired by Division 26.

3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.

E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).

2. Each supplier of a control's product shall configure, program, start up, and test that product to meet the sequences of operation described regardless of where within the contract documents those products are described.

3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.

4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.

D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

A. Commissioning and start-up of the BAS system shall be performed factory certified employees of the BAS contractor or manufacturer. Under no instances shall electrical subcontractors perform this work.

B. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).

C. Continually monitor field installation for code compliance and workmanship quality.

D. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 WIRING

A. Provide blue control conduits and independently supported control wiring. Coordinate concealed-space cable/raceway requirements with District Division 26 standards; exposed or unsupported loose cabling in concealed walls, above hard ceilings or chases is not acceptable. Use code-compliant raceway, boxes and short device whips where permitted.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. To differentiate BAS wiring from that of other trades, all cable except for underground will have a **yellow outer jacket** (no exceptions).

C. Division 26 contractor shall supply a dedicated 120vac power to a junction box in each mechanical room for use by the BMCS.

D. A Conduit fill based on plenum 18-gauge 2 conductor:

1. 1/2 inch - No more than 4 conductors.

2. 3/4 inch - No more than 8 conductors.

3. 1 inch - No more than 12 conductors.

E. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.

F. All wires whether control network or device wire shall be marked with Brady-type markers.

G. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.

H. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.

I. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.

J. Install wiring in raceway where subject to mechanical damage and at levels below 10ft. in mechanical, electrical, or service rooms.

K. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

L. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.

M. Do not install wiring in raceway containing tubing.

N. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at (5 ft) intervals.

O. Contractor shall install all low voltage communication wiring as per all TIA/EIA communication cabling standards. All cabling shall be installed in dedicated cabling support such as j-hook, d-rings, or saddles. All supports shall be supported directly from building structure. Do not support cabling or supports from ceiling grid wire, conduit, ductwork, piping, or other system cabling. All cabling must be installed in independent support for that given system and may not share supports or run-in same conduit or support. All cabling shall be supported every 5’-0” from approved cabling support method.

EQUIPMENT SHALL BID AS AN ALTERNATE

Contractor shall bundle all system cabling and label all wiring for system they serve. All cabling passing thru walls shall require dedicated conduit sleeves with bushing to protect cabling during installation. Contractor shall provide 1 meter service loops at all device termination locations and 3-meter service loops at all head end termination locations. All low voltage HVAC control cabling shall be yellow in color unless specified otherwise. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.

P. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.

Q. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.

R. Include one pull string in each raceway 2.5 cm (1 in.) or larger.

S. Use color-coded conductors throughout.

T. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.

U. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.

V. Adhere to requirements in Division 26 where raceway crosses building expansion joints.

W. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.

X. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.

Y. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size.

Z. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.7 COMMUNICATION WIRING

A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).

B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.

C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.

EQUIPMENT SHALL BID AS AN ALTERNATE

D. Verify entire network's integrity following cable installation using appropriate tests for each cable.

E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.

F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.

G. Label communication wiring to indicate origination and destination.

H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.8 FIBER OPTIC CABLE

A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.

B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.9 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.

B. Mount sensors rigidly and adequately for operating environment.

C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.

D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.

E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft. ^{2} of coil area.

G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

H. Install outdoor air temperature sensors on north wall at designated location with sun shield.

I. Differential Air Static Pressure.

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.

2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.

3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.

4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.

5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.

6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.

J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

A. Adjust flow switch according to manufacturer's instructions.

3.11 ACTUATORS

A. General. Mount actuators and adapters according to manufacturer's recommendations.

B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.

1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.

2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

4. Provide necessary mounting hardware and linkages for actuator installation.

EQUIPMENT SHALL BID AS AN ALTERNATE

3.12 IDENTIFICATION OF HARDWARE AND WIRING

A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.

B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.

C. Permanently label or code each point of field terminal strips to show instrument or item served.

D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.

E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.

F. Label valves with nameplates.

G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.

H. Label identifiers shall match record documents.

3.13 PROGRAMMING

A. Do not use classroom motion/occupancy sensor status to disable air conditioning. Provide BAS freeze-protection pump override where chillers or boilers normally command their own pumps, and hardwire equipment enable as required. OEMs shall retain DX system safety and internal device control; BAS may command normal enable and heating/cooling requests and read alarm/status. Provide outdoor-temperature lockouts for chillers/boilers per approved sequences.

B. Outdoor air units shall monitor outdoor air temperature and humidity and modulate dehumidification according to ambient conditions and approved sequence. Provide regionally appropriate humidity control and required ventilation; maintain the pressure relationship scheduled by EOR. Confirm blanket positive room pressure requirement does not conflict with laboratory/toilet/kitchen exhaust and code-required negative pressure areas.

C. Provide an appropriately labeled master HVAC fan shutdown station near the administration / principal office area, coordinated with the fire / life-safety sequence. Do not shut down science lab purge exhaust or emergency kitchen hood exhaust functions required for emergency use. Provide a labeled two-hour administration HVAC override pushbutton near the office area, subject to Owner approval and Division 26 coordination.

D. Where included in the project: integrate boiler/CHW pumps, cooling tower fans, AHUs, fresh-air fans, equipment flow switches and kitchen exhaust interlocks. Interlock kiln operation with exhaust; allow independent exhaust operation and BAS proof and post-purge. Provide kitchen exhaust/hood overrides including an emergency exhaust-only override, coordinated with manufacturer requirements and life safety.

E. If BAS-controlled lighting is included in project scope, provide separately zoned exterior lighting, HOA at contactors/graphics, lighting status verification, site plan graphics, Owner-approved schedules, and clearly labeled two-hour pushbutton lighting override.

EQUIPMENT SHALL BID AS AN ALTERNATE

Exclude safety/emergency lighting control and comply with school-level limitations on interior lighting control. Coordinate specific requirements with Division 26 and Owner.

F. Point Naming. Name points as shown on the equipment points list provided with each Sequence of Operation. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.

G. All DDC programming shall be accomplished through graphical programming, line code is unacceptable

H. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented.

1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.

2. System Programming. Provide system programming necessary for system operation.

I. Operator Interface.

1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List located in the Sequence of Operation. Point information on graphics shall dynamically update.

2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.

3. DDC screen graphic room numbers shall be based on final room graphics package. Obtain Architect/Owner approval of final room numbers prior to programming.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.

1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.

2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.

3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.

5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.

6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.

7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.

8. Alarms and Interlocks.

   Prior to TAB, submit a written field-verified functional checkout of all BAS hardware, software, input/output points, controller alarms and graphics; confirm installed graphics are functioning on Owner workstation before Substantial Completion.

   a. Check each alarm with an appropriate signal at a value that will trip the alarm.

   b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.

   c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.15 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.

1. Preliminary Review: At least 7 days prior to on-site demonstration, provide read-only username and password to Engineer for preliminary system review to be performed remotely. Engineer will review to verify all systems are connected and communicating and all points are reading properly, and graphics are complete. The Engineer will provide a report of any deficiencies. The contractor shall correct all deficiencies prior to on-site demonstration.

2. On-site Demonstration: Engineer, Owner, contractor(s) and any/all factory authorized equipment representatives shall be present to perform, observe and review system demonstration. Notify Engineer/Architect at least 10 days before system demonstration is scheduled.

EQUIPMENT SHALL BID AS AN ALTERNATE

a. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.9 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.

b. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.

c. Demonstrate compliance with sequences of operation through each operational mode.

d. Demonstrate complete operation of operator interface.

e. Demonstrate each of the following.

f. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.

g. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.

h. Building fire alarm system interface.

i. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph F.11 (Trend Configuration).

3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer

will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.9 (Submittals).

3.16 CLEANING

A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.

B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.

C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 23 09 23

SECTION 23 09 23.18 - CARBON MONOXIDE MONITORING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract and the requirements of Section 15050 apply to the work specified in this Section.

B. Gas detection system must meet or exceed Texas State Boiler Code 60.603-2015.

C. ETL Listed to UL61010-1, CAN/CSA C22.2 No 61010-1, and LADBS Approved.

D. Gas detection system must meet or exceed current OSHA and NIOSH alarm levels for personnel exposure to Carbon Monoxide.

1.2 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Submit in accordance with Division 1 and Section 23 05 00.

C. Provide Monitor Panel as required to provide function in this specification and as shown on drawings.

D. Provide panels with electrical characteristics shown on the electrical drawings.

E. Carbon Monoxide system shall be third party validated to UL61010.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for operation, replacement parts, spare parts list, and wiring diagrams.

1.4 WARRANTY

A. Furnish one (1) year manufacturer parts and labor warranty for complete monitoring system. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup will not be acceptable.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) year’s experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Monitoring system shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or

other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. International Gas Detectors Tocsin controller & detector range.
2. Honeywell / Vulcain

2.2 CARBON MONOXIDE (CO) GAS DETECTION SYSTEM

A. Provide a CO gas detection system designed to measure the level of escaping heating plant exhaust gases in multiple monitoring areas.

B. Gas detection must consist of a control panel that must be mounted outside of the risk area to enable pre-entry warning of room status and provide remote reset capability for the system (only once gas concentrations have reduced below any alarm levels).

C. Gas detection system must be capable of being expanded to include flammable gas detection (to cover the fuel gas leakage and ignition/explosion risk) and refrigeration detection to enable interconnection to co-located Chiller Plant Areas without any loss of monitoring or alarm performance.

D. **Shall be calibrated every (18) eighteen months and a record of calibration shall be posted in a conspicuous place.**

E. Gas detection system enclosures for controllers or detectors should be a minimum of NEMA 3S (IP54).

F. The gas detection system should consist of a central controller interconnecting with field mounted gas detectors of Electrochemical Cell technology. Interconnection between controller and field devices should be through a 2-core addressable multi drop highway highways depending on detector numbers and locations relative to controller. Detectors being mounted to best cover risk area according to current manufacturers and industry advice.

1. The gas detection system should be an addressable type interconnecting to all field devices on a 2-core screen mutli-drop highway. Controller should have a minimum of a single highway expandable to 32 gas detectors.

2. Addressable highway should have polarity independent cores utilizing Sentinel+ addressable protocol enabling simple and quick install without need for core identifications. Addressable highway should have a capacity of 32 detectors.

3. The gas detection system shall automatically and continuously monitor for CO over the range 0-100 ppm and compare concentrations to user-settable PPM limits per areas monitored for selected gas.

4. Gas detection system to be capable of zoning alarm areas to enable a co-located Chiller Plant Room to be incorporated into locally fitted Heating Plant Room systems but provide independent alarms.

5. The gas detection system shall be capable of being calibrated specifically for CO over the range 0-100 ppm to enable compliance to local and national codes.

6. The gas detection system shall be capable of interconnecting with and monitoring Electrochemical Cell technology with factory and field calibrated settings. Measurement range for CO will be 0-100ppm with an accuracy of +/-3% as a percentage of full scale in ambient temperature ranges of 32 to 122 degrees Fahrenheit and 5 percent to 90 percent ambient humidity (non-condensing).

7. The gas detection system controller shall have a minimum of:

    a. Common 24VDC 100mA output common to any alarm.

    b. Four (4) SPCO alarm contacts -three (3) are for alarm levels and one (1) for system fault.

    c. Three (3) indicator lights:

        1. green “on” for normal operation
        2. red “on” for alarm
        3. yellow “on” for system fault

    c. Modbus RS485 output for connection to external devices with full Modbus Map freely available for 3rd parties.

    d. Alarm and fault log capability for. Minimum of 1000 points.

7. All configuration and monitoring parameters on the gas detection controller may be accessed one or two ways concurrently:

    a. Via web enabled devices accessing controllers on-board Wi-Fi pages; access must be Password protected.

    b. Via Wi-Fi dongle connected onto detector (allowing access to all devices on highway); access must be password protected.

8. Three alarm levels shall be provided indicating three (3) independent “alarm” level conditions. Thresholds for all alarms are to be individually adjustable with a factory setting of 20 PPM for “Alarm 1”, 50 PPM for “Alarm 2”, and 100 PPM for “Alarm 3”. To minimize false alarms, the unit’s minimum/maximum alarm levels should be set at factory recommended settings in compliance with relevant local and national codes.

8. System should be capable of operation even though a fault occurs. Controller should have a fault Indicator light and display should detail nature of the Fault.

9. The gas detection system should have an electronics warranty of minimum 10 years; sensor warranty for CO to be a minimum of 3 years.

10. Periodic gas detection system bump testing, calibration and checking or adjustments shall be capable of being accomplished by one person. Gas detection system shall have a self-diagnostics and indication of diagnostic status. Diagnostics shall include the CO sensor/s.

11. Installation of gas detection system should follow manufacturers installation recommendations (see IGD 2 Wire Installers Guide).

2.3 GAS DETECTION CONTROL PANEL

A. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

B. The control panel should have an auto-setup function upon initiation. Upon first powering the device should ask for a FIND function that enables it to interrogate the connected highway, recognize and download details of all connected devices and automatically set channels and alarm points without any personnel interaction.

C. The control panel provides remote programming, interrogation, and display functions to support the field mounted gas detectors. The system design supports compliance to the local and national codes.

D. The control panel accepts a minimum of 1 Sentinel+ addressable input capable of monitoring up to thirty-two (32) field mounted detectors.

E. Gas detector readings should be updated a minimum of once per second.

F. Back lit LCD – The “Display” mode will display the measured point in PPM. The display will show a green backlight to reflect a safe condition and the light ring around the controller jog wheel will also be backlit green.

G. The control panel should have the ability to log a minimum of 1000 events (alarms, resets, power activities etc.)

H. Upon alarm, the channel display displays the channel in alarm (with live gas data), the backlit display changes from GREEN SAFE to RED , the light ring around the jog wheel changes from GREEN to RED, an internal 85dB sounder activates and the red alarm LED illuminates. Depending upon alarm Cause & Effect one or more of the SPCO, 230VAC 4Amp programmable relays change state.

I. The LCD display indicates any input fault that may occur and identifies the fault area, upon FAULT the display will be backlit YELLOW, the light ring around the jog wheel changes from GREEN to YELLOW.

J. The Control Panel shall provide Modbus RS485 to enable to operate in parallel with building management systems for the monitoring and interrogation of the control panel data.

K. Control panel shall be able to “lock out” any instructions through the local keypad by password.

L. Upon power failure, the control panel will have the capability to restart all individual monitors on the system. Upon return of electrical power, the control panel will be able to re-boot itself and return to operation without loss of programming or stored data (one month downtime without loss of data as a minimum).

M. The control panel should be capable of operating devices up to 3000 feet from controller location dependent on cable core size and detector location.

N. Two-way communication via Sentinel+ to a maximum of 32 detectors linked together in daisy-chain fashion is required. An onboard Wi-Fi port should enable password protected access by any web enabled device.

O. The control panel shall have an operating temperature of 32° – 122°F.

P. The control panel power consumption shall be less than 10 watts maximum 85-230VAC and be capable of running on 50 to 60 HZ power supply.

Q. There shall be one common 24VDC output for local beacon sounders and four (4) relays in the monitor unit. Four (4) relays shall be available for customer connections. All relays shall be rated at 230VAC 4 AMP. Alarm relays shall be capable of being programmed within the gas detection range and options to be Rising or Falling, Latched alarms or Auto-reset, energized or none energized configurations.

1. ALARM 1: The Alarm relay connection shall be provided for the addition of an audible or visual warning device, fan activation or Plant shutdown. This relay will energize in the event that an area for Alarm 1 level has been exceeded.

2. ALARM 2: The Alarm relay connection shall be provided for the additional of fan activation or plant shutdown. This relay will “energize” in the event that an area for Alarm 2 level has been exceeded.

3. ALARM 3: The Alarm relay connection shall be provided for the additional of fan activation or plant shutdown. This relay will “energize” in the event that an area for Alarm 3 level has been exceeded.

4. FAULT: The Fault relay shall be a normally energized relay automatically changing state upon FAULT or Power Loss.

R. Unit power consumption shall be less than 50 watts maximum, 230 volts AC and be capable of running on 60 Hz supply.

S. Program access to be denied by password to prevent unauthorized personnel from accessing the device. Program will automatically reset to full function settings following power interruption.

T. Gas detection. Controller must be capable of operating additional flammable detectors (for fuel gas leak detection within Heating Plant Room and/or refrigerant detectors for Chiller Room.

U. Gas detection system to be capable of zoning alarm areas to enable Chiller Plant Room systems to be incorporated into locally fitted Heating Plant Room systems but provide independent alarms.

V. Wiring connections shall be through 20mm electrical ports located on the bottom panel of the enclosure. Rear of control panel should be capable of being rotated to enable cable ports to be placed top or bottom. Rear panel knock outs should also be provided for cable entries.

2.4 GAS DETECTORS

A. The gas detectors shall be electrochemical cell technology with factory and capable of field calibration.

B. Gas detectors must be provided pre-calibrated and be able to interact with the control panel during its initial FIND operation to automatically set up the details of gas type, range and alarm points.

C. Gas detectors shall be 2 wire addressable technology compatible with Sentinel+ protocol and polarity independent connection.

D. Gas detectors shall have inboard I/O to enable (as a minimum) a 24VDC beacon sounder to be connected locally (maximum rating 100mA). Beacon sounder functions to be split for independent beacon & sounder operation (muting etc.).

E. Gas detectors to have an onboard Volt Free SPCO Relay rated 230VAC 4 Amp to enable local switching of plant (ventilation, heating plant de-activation, solenoid closure etc.).

F. Gas detectors should have a “hot swappable” front that enables gas sensors to be exchanged at end of life, upgraded, or swapped to other technologies or gas types upon plant change requirements.

G. Measurement range for CO with an accuracy of +/- 3% of full scale in ambient temperature ranges of 32 to 122 degrees Fahrenheit and 5 percent to 90 percent ambient humidity (non-condensing).

H. The gas detection system shall adhere to a temperature drift tolerance of 0.3 percent per degrees Celsius and have a sensitivity of 1 PPM (parts per million).

I. Gas monitoring should be continuous.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panels and all detectors as shown on the drawings. Sufficient clearances allow easy service, maintenance, and replacement components.

B. Controller should always be placed outside of the Plant Room to enable pre-entry warning to personnel of room status.

C. Remote reset capability for the system should be at the controller and external of the Heating Plant Room.

D. Provide a combination strobe light and horn inside plant room to enable an evacuation alarm to be provided. The audible alarm shall be heard over the background room noise. The strobe light shall be energized when there is an alarm.

E. Installation of gas detection system should follow manufacturers installation recommendations (see IGD 2 Wire Installers Guide).

F. Demonstrate all functions of CO gas detection system.

G. Train the Owner on operations and maintenance of CO detection system.

3.2 SEQUENCE OF OPERATION

A. Refer to Section 23 09 93 Sequence of Operations for HVAC Controls for detailed CO sequence of operation requirement.

B. Carbon Monoxide detection system shall monitor the presence of CO in the Heating Plant Room. If CO is detected, a scaled automatic system of room evacuation and plant shutdown will be initiated linked to detected gas concentrations. The following sequence shall also be initiated from a manual switch located on the CO detection system panel. The CO system supplier shall provide a "dry" set of contacts, initiated automatically. On activation of the contacts, the following sequence shall occur.

1. Exhaust fan (Refer to plans for tag) shall be energized to high speed (if in place).,

2. Heating plant (refer to plans for tag) shall be de-energized to prevent further gas propagation.

3. BAS to be informed of alarms.

4. Provide an audible and visual alarm in the Heating Plant Room. Initiate the alarm and flash the light when the exposure limit is exceeded.

5. Control sequence above shall be accomplished by hard wire interlocks.

3.3 DEMONSTRATION AND TRAINING

A. Demonstrate system operations and verify specified performance. A functional test of the installed system shall be performed to demonstrate proper functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.

END OF SECTION 23 09 23.18

SECTION 23 09 93 - SEQUENCES OF OPERATION FOR HVAC CONTROLS

GENERAL:

- The BAS contractor shall provide all points listed under “Equipment Control Points” as well as any points required to accomplish the sequences of operation listed below. Refer to Specification 23 09 23 for input/output device specifications. Refer to contract drawings for additional items that may not be included in this specification. At the 11 month walk-thru, BAS contractor shall provide an additional DDC demonstration (in addition to the demonstration before substantial completion) and re-verification of point-to-point control of all equipment points and sequences with Owner and Engineer; no exceptions.

- **BAS subcontractor shall assist Commissioning Agent throughout entire commissioning process to prove functionality as designed. Site visits and meetings shall be required at a minimum.**

- Division 26 contractor shall supply dedicated 120vac power to a junction box in each mechanical room for use by the BAS.

- Building automation systems sub-contractor shall provide and install step down transformers in each mechanical room and run low voltage communication wiring power loops to serve low voltage actuators installed at each Single Duct Air Terminal Unit.

- All Hydronic control valves and associated actuators shall be manufactured by Belimo.

- BAS contractor shall schedule and participate in a pre-construction integration meeting with all vendors providing BACnet/Modbus or other equipment that is being integrated to the BAS. Sample graphics shall be submitted for owner review. The meeting is a requirement and shall include but not limited to:

    - Communications Requirements (MSTP/IP)
    - Points (Read/Write)
    - Connection Requirements (CAT5/6, 2-wire, 4-wire)
    - Coordinate Communication speeds when devices are MSTP.
    - Coordinate or Establish Device Instance Numbering System
    - Coordinate final points list(s) with owner/engineer

- All BAS exposed control wiring below the ceiling and especially outdoors (rigid) shall be in conduit; furnished and installed by bas subcontractor.

- All new chillers and boilers shall be provided with a BACnet card. BAS shall provide and install wiring for interface.

- No portion of the total contract will be declared substantially complete until the graphics and automatic temperature control system has been demonstrated to be complete and functioning as intended. The BAS system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point.

- All outside air dampers serving an air handler with untreated outside air shall be stainless steel. Mount outside air dampers in lower elevation without the use of a ladder for accessibility. The controls contractor is responsible for providing dampers to be installed within duct for mechanical contractor to install. Outside Air Handling Units shall be provided with factory mounted dampers; BAS contractor shall provide actuator. Coordinate with unit’s manufacturer for damper sizes.

- BAS is to provide control dampers and Belimo actuators for equipment such as Exhaust fans, Outside Air Intakes and Supply Fans.

- Zone Sensors located in common areas shall have a lockable plastic cover. Sensors in the gymnasium must be mounted above any potential padding. Provide additional sets of keys.

- The controls contractor and equipment manufacturer rep are required to coordinate to ensure points are monitored, displayed and commanded as needed in order for the end user to have a fully functional system. This includes all readable and writable points for the respective equipment.

1. CHILLED WATER SYSTEM – MAIN CENTRAL PLANT

The chilled water system shall consist of three (3) air-cooled chillers arranged in a variable primary flow configuration. Two (2) chillers shall be designated as duty chillers, with the remaining chiller serving as standby. Under no circumstances during normal automatic operation shall more than two (2) chillers and two (2) chilled water pumps operate simultaneously.

The system shall utilize three (3) variable speed chilled water pumps connected to common supply and return manifolds. The pumps shall not be dedicated to individual chillers, allowing any pump to operate with any combination of available chillers.

Pump operation shall be determined independently of chiller operation, based upon system differential pressure, chilled water flow demand, and equipment availability.
One (1) chilled water pump shall remain in standby during normal operation. The BAS shall automatically alternate the operating and standby pumps based on cumulative runtime.

The system shall incorporate automatic isolation valves at each chiller and minimum-flow protection as required to maintain the operating chillers within the manufacturer's allowable evaporator flow limits.

BAS shall provide BACnet interface to each chiller for monitoring in addition to control described below.

Equipment Control Points:
Building CHW supply temperature – AI
Building CHW return temperature - AI
Building CHW differential pressure – AI
Building CHW supply flow – AI
Chiller amps/status, each chiller -AI
Chiller CHW supply temperature, each chiller – AI
Chiller alarm, each chiller - DI
CHP pump status, each pump - DI
Chiller start/stop, each chiller - DO
CHP pump start/stop, each pump - DO
CHP pump speed control – AO
Chiller Reset, each chiller - AO
Isolation Valves, each chiller – DO
Isolation Valves Feedback - DI

Chilled Water System Activation

The chilled water system shall be activated by a request for cooling from any unit it supplies with chilled water. The number of cooling requests required and the length of time the requests must be received before activating the plant shall be operator adjustable. The chilled water system shall be disabled if the outside air temperature is less than 45°F (operator adjustable).

Chiller Activation

Prior to enabling the lead chiller, the BAS shall command the associated chiller's automatic isolation valve(s) open. The BAS shall verify the isolation valve(s) are in the fully open position through valve end switches or position feedback before enabling the chiller. Once the required flow through the chiller has been proven, the BAS shall enable the chiller to operate. If the isolation valve(s) fail to prove open within 30 seconds (adjustable), the BAS shall inhibit the chiller start, generate an alarm, and initiate the next available chiller in sequence. When the chilled water system is activated, the BAS shall start the lead primary chilled water pump. A current switch shall prove status to the BAS control module and shall alarm at the central site if a switch is not made within 20 seconds (adjustable). When pump status has been proven for 1 minute (adjustable), the BAS shall start the lead chiller. When chilled water flow has been proven by flow switches, the chiller shall start and maintain its leaving water temperature by its own internal controls. If the chiller fails to start within 2 minutes (adjustable), the BAS shall shut off its chilled water pumps and alarm the central site. If the chiller trips an internal alarm, it shall notify the BAS system through a set of normally closed contacts.

Chiller Lead/Lag Rotation

The BAS shall automatically rotate the three (3) chillers based on cumulative operating hours to maintain approximately equal runtime across all three units.
The chiller with the lowest accumulated runtime shall be designated as lead, the next lowest as lag, and the remaining chiller as standby.
Chiller assignments shall be evaluated weekly at an operator-adjustable time and whenever equipment becomes unavailable.

The BAS shall maintain the following operating restrictions:

- Maximum two (2) chillers operating simultaneously.
- Minimum one (1) available chiller designated as standby.
- No chiller shall be simultaneously commanded to operate and commanded isolated.
- Chillers removed from service shall be excluded from automatic rotation.
- Chiller rotation shall occur through a controlled transition that maintains required water flow.

During chiller lead/lag rotation, the BAS shall open and prove the isolation valve(s) of the incoming chiller prior to enabling the chiller. The outgoing chiller shall be disabled and its required post-run circulation completed before closing the associated isolation valve(s). The BAS shall coordinate valve operation and pump speed to maintain the manufacturer's required evaporator flow through operating chillers throughout the transition. Under no circumstances shall more than two (2) chillers operate simultaneously during the rotation. The BAS shall continuously monitor each chiller's availability, operating status, accumulated runtime, alarms, and capacity.
In the event an operating chiller fails, the BAS shall disable and isolate the failed chiller in accordance with the manufacturer's shutdown requirements and enable the available standby chiller.
The failed chiller shall be removed from the automatic staging sequence until the fault is cleared.

Chiller Staging

The BAS shall initially enable (1) Chiller based upon lowest cumulative runtime unless If the outside air temperature is greater than 65°F (adjustable) (2) chillers shall be enabled based on lowest to greatest runtime.

A current sensor at each chiller shall monitor the amperage of each chiller. The BAS shall also receive temperature inputs from sensors mounted in the building’s common supply and return piping. If the enabled chiller or chillers current load monitor indicates that the chiller or chillers are operating above 95% capacity and the building supply water temperature rises greater than 3°F (adjustable) above set point for five (5) minutes (adjustable) the next chiller in sequence shall be enabled into operation by the above-described sequence. Prior to staging on an additional chiller, the BAS shall command the additional chiller's isolation valve(s) open and verify the fully open position. The BAS

shall confirm adequate minimum evaporator flow through both chillers before enabling the additional chiller. When staging down from two chillers to one, the BAS shall disable the selected chiller, maintain required post-run circulation, and then close its associated isolation valve(s). The remaining chiller's isolation valve(s) shall remain open, and the BAS shall adjust pump speed as required to maintain system differential pressure and evaporator flow.

With more than one chiller operating, if the combined load decreases to 80% (adjustable) capacity of one less chiller for ten (10) minutes (adjustable) and the building supply water temperature is less than 3°F (adjustable) above set point, a chiller shall be de-energized.
The sequencing of the chillers shall be as follows but the operator shall be able to modify the sequencing of the chillers or disable any chiller and remove it from the sequence.

Sequence #1 – ACCH-01, ACCH-02 or ACCH-03 (runtime dependent)
Sequence #2 – (2) CHILLERS AT MOST IN ANY SEQUENTIAL ORDER (runtime dependent)

Note: If available, use the chillers BACnet %capacity as the main capacity control point and the amperage as the backup control point.

Chilled Water Temperature Control
The chiller's internal controls shall maintain its chilled water supply temperature set point of 45°F (locally adjustable). Verify the BAS control programs set point matches local set point of the chiller(s).

Chilled Water Demand Control
A current sensor at each chiller shall monitor the amperage of each chiller. The BAS shall also receive temperature inputs from sensors mounted in the building's common supply and return piping. If the enabled chiller or chillers current load monitor indicates that the chiller or chillers are operating above 95% (adjustable) capacity and the building supply water temperature rises greater than 3°F (adjustable) above set point for five (5) minutes (adjustable) the next chiller in sequence shall be enabled into operation by the above-described sequence.

With more than one chiller operating, if the combined load decreases to 80% (adjustable) capacity of one less chiller for ten (10) minutes (adjustable) and the building supply water temperature is less than 3°F (adjustable) below set point, a chiller shall be de-energized.

The chiller programming shall be set up so that the owner can choose the increment/decrement sequence of the chillers for associated modes.

The equal size chillers shall be lead-lag alternated weekly by the BAS based upon cumulative runtime.

The chillers shall run for a minimum of 10 minutes (adjustable) to prevent short cycling, and their chilled water pumps shall continue to run for an additional 5 minutes (adjustable) to insure adequate flow during shutdown.
One pump is to be in stand-by mode at all times.

Variable Primary Chilled Water Pump Control
The chilled water pumping system shall operate independently of the chiller lead/lag sequence.
All chilled water pumps shall be connected to common supply and return manifolds and shall be capable of serving any combination of operating chillers.

The BAS shall select the lead operating pump based on lowest cumulative runtime.
When the chilled water system is enabled, the BAS shall start the lead pump and modulate its speed through its variable frequency drive to maintain the building chilled water differential pressure setpoint.

The BAS shall monitor differential pressure and total chilled water flow to maintain adequate water circulation through the building and operating chillers.

A differential pressure sensor across the building chilled water supply and return lines for secondary system shall monitor building differential pressure across the mains. The BAS shall modulate the speed of the operating secondary chilled water pump to maintain the building chilled water differential pressure at setpoint (adjustable). If the lead SCHP is operating at greater than 90% (adjustable) and the building differential pressure is greater than 3 psi (adjustable) below setpoint for 5 minutes (adjustable) the lag SCHP shall be started in tandem with the lead pump. The lag pump shall run until both pumps are operating at less than 30 % (adjustable) for 5 minutes (adjustable) at which time the lag pump shall be disabled.

The BAS shall monitor the position of all of the chilled water valves of the units that each secondary pump set serves and the differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The chilled water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

Pump Staging

If the operating pump or pumps exceed 90% speed (adjustable) and system differential pressure remains more than 3 psi below setpoint for five (5) minutes (adjustable), the BAS shall enable the next available pump.

The operating pumps shall modulate in parallel to maintain the system differential pressure setpoint. If the combined pumping demand decreases and operating pumps remain below 30% speed (adjustable) for five (5) minutes (adjustable), the BAS shall disable the pump with the greatest cumulative runtime, provided remaining pumps can maintain differential pressure and required minimum chiller flow.

Pump staging and de-staging shall not cause the flow through any operating chiller to exceed the manufacturer's allowable flow limits or permissible rate of flow change.
One pump shall remain in standby during normal operation. (There should never be (3) pumps running simultaneously)

Pump Alternation

The BAS shall automatically alternate the pumps weekly, based on cumulative operating hours, with the lowest-runtime available pumps receiving priority.
If an operating pump fails to prove status within twenty (20) seconds (adjustable), the BAS shall:

1. Disable the failed pump.
2. Generate a pump failure alarm.
3. Open the required standby pump isolation valve.
4. Enable the next available pump.
5. Resume differential pressure control with the remaining available pumps.

Pump alternation and replacement shall be completed without interrupting the minimum required flow through operating chillers.

Minimum Chiller Flow Protection

The BAS shall monitor and maintain chilled water flow through each operating chiller within the manufacturer's allowable minimum and maximum flow limits. The BAS shall monitor the commanded status and actual position of each chiller's automatic isolation valve(s). A chiller shall not be enabled unless the associated isolation valve(s) are proven fully open and adequate evaporator flow has been established. If an operating chiller's isolation valve indicates an unexpected, closed position or loss of open-position proof, the BAS shall generate an alarm and initiate the manufacturer's required chiller

protection sequence. The BAS shall maintain the associated flow path as required to complete the safe shutdown sequence.

A modulating minimum-flow bypass valve, where provided, shall be controlled to maintain minimum required evaporator flow when building demand decreases below the operating chillers' minimum flow requirements.

The bypass valve shall remain closed when sufficient system flow is available and shall modulate open as required to maintain minimum evaporator flow.
The minimum required flow setpoint shall automatically adjust based on the number and configuration of operating chillers.

During chiller staging and pump staging transitions, the BAS shall limit the rate of flow change to the operating chillers in accordance with manufacturer requirements.
Failure to establish or maintain minimum evaporator flow shall inhibit chiller startup or initiate the applicable equipment shutdown sequence.

Chilled Water Differential Pressure Reset
The BAS shall monitor building chilled water differential pressure and the positions of the chilled water control valves served by the system.

The differential pressure setpoint shall reset to maintain a target critical control valve position of 90% open (adjustable), with a 5% deadband (adjustable).

The BAS shall modulate operating chilled water pump speeds to maintain the reset differential pressure setpoint while maintaining the minimum evaporator flow requirements.
All reset and staging parameters shall be operator adjustable.

Chiller Shutdown
When a chiller is commanded to shut down, the BAS shall disable the chiller in accordance with the manufacturer's required shutdown sequence. The associated automatic isolation valve(s) shall remain fully open during the required post-run circulation period, initially five (5) minutes (adjustable), or as required by the chiller manufacturer.

Upon completion of the required post-run circulation period and confirmation that the chiller is no longer operating, the BAS shall command the associated isolation valve(s) closed. The BAS shall verify valve closure through position feedback and generate an alarm if the valve(s) fail to close within the operator-adjustable time period.

Because the chilled water pumps are connected to common manifolds and are not dedicated to individual chillers, shutting down an individual chiller shall not automatically shut down any particular pump. The BAS shall adjust pump speed and flow as necessary to maintain the required system differential pressure and minimum evaporator flow through any remaining operating chillers.

Freeze Protection
When the outdoor air temperature drops to 34°F (adjustable) or below and the building is in the unoccupied mode, the BAS shall open the chilled water valves to 60% (adjustable) for flow through the coils for freeze protection and the chilled water pump system shall be activated to run until the low ambient temperature ceases to exist.

Equipment off Conditions
When the chilled water system is inactive, the chillers and chilled water pumps shall be off.

2. HEATING WATER SYSTEM

The heating water system is a fully condensing boiler hot water system with primary/secondary pumps and condensing boilers. The boiler system shall be controlled by a sequencing panel provided by the boiler manufacturer equipped with a BACnet interface card for each boiler. The BAS contractor shall provide a BACnet interface to each boiler to communicate with the sequencing panel to request the heating water system and monitor pertinent data from the boilers such as but not limited to leaving water temperature, status, alarm, etc. Two secondary pumps, SWHP-01 and SWHP-02, shall never run in tandem. One (1) pump shall serve as duty and the other shall serve as standby. Each pump shall alternate in order to receive equal runtime.

The controls contractor shall provide capability for S/S for individual boilers in order for end-user to have the capability to start an individual boiler master controller or BACnet interface is down. Controls contractor and boiler equipment provider are to coordinate to ensure wire is pulled, but not landed, so that cascade capability is present if owner desires to terminate and enable system or enabling individual boilers through the control system. NOTE: This is either/or and both scenarios cannot be accomplished together.

BAS shall provide low voltage control wiring and conduits connecting the boilers and for the end devices. BAS to provide conduit and 2 sets of 3 conductor shielded communication wire between boilers for CASCADE and BMS. BAS to provide conduit and wiring for hardwire of the LWCO and System HWS Temp Sensor.

Equipment Control Points:
Building HW supply temperature – AI
Building HW return temperature – AI
Building HW Return Flow Meter - AI
Boiler supply temperature – AI (each Boiler)
Boiler status – DI (each Boiler)
Boiler alarm – DI (each Boiler)
HW Pump status (each pump) – DI
Boiler-1 S/S – DO
Boiler-2 Status – DI
Boiler HWS Temp Sensor – HW to boiler controller for each boiler
HW pump start/stop (each pump) – DO
HW Pump speed control (each pump) – AO
Hot Water differential Pressure – AI
Carbon Monoxide Level – AI
Boiler Room Space Temperature – AI
Boiler Room Supply Fan Start/Stop -Hardwired to damper end switch
Boiler Room Supply Fan Status – DI
Boiler Room Supply Fan Damper w/End switch– DO/HW 24v to fan S/S
Boiler Room Exhaust Fan Start/Stop -DO
Boiler Room Exhaust Fan Status – DI
Boiler manufacturer provided headered temperature sensor for controls to wire back to boiler – HW

Heating Water System Activation
The heating water pump shall be activated by a request for heating from any equipment it supplies with heating water. A current switch shall prove status to the BAS and shall alarm at the central site if the contacts are not made within 20 seconds (adjustable). Once the heating water pump has proven positive flow, the BAS shall request the boiler system to run.

If the hot water supply temperature is less than 100°F (adjustable) or the building hot water pump status is not indicating the building hot water pump is running, the BAS control module shall broadcast that hot water is not available.

The BAS will enable the system. The boiler sequencer decides who is lead and brings on the lag. The boiler controller also auto rotates if an alarm on the lead boiler is indicated.

Differential Pressure Control
A differential pressure sensor across the building heating water supply and return lines shall monitor building differential pressure across the mains. The BAS shall modulate the speed of the lead heating water pump to maintain the building heating water differential pressure at setpoint (adjustable - final setpoint determined by TAB contractor).

The BAS shall monitor the position of all of the heating water valves and the differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The heating water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

HW Pumps shall be rotated weekly to maintain equal runtime. One pump is to be in stand-by mode at all times.

Heating Water Temperature Reset: The heating water shall have a ratio as coordinated with boiler manufacturer rep to ensure the ensure this function is operating as required.
Reset based on outside air temperature and the following schedule:

Outside Air Temp	Less than 50°F	Hot Water Temp	140°F
Outside Air Temp	Greater than 70°F	Hot Water Temp	100°F

Carbon Monoxide Monitoring
A carbon monoxide sensor installed in the boiler room will alarm the BAS and shut down the boiler. The BAS shall notify district maintenance personnel via e-mail and text message when the level of carbon monoxide rises above 100 ppm. The sensor shall also alarm the BAS and shutdown the boiler upon loss of power to the sensor. Boiler Room supply fan **SF-01** will be de-energized, and the emergency exhaust fan **EF-02** will be energized to dilute the carbon monoxide levels in the room. A strobe light and audible alarm at the panel will be activated during an event. A push button on the panel will silence the alarm and reset the system. Carbon monoxide sensor shall be calibrated every eighteen months and a record of calibration shall be posted in a conspicuous place.

Freeze Protection
When the outdoor air temperature drops to 35°F (adjustable) or below, the BAS shall open the hot water valves for flow through the coils for freeze protection. The hot water system shall be activated to run and the building HW supply set point shall be set to 85°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist or the building start-up time arrives.

Boiler Room Supply Fan
The BAS shall start/stop the supply fan **(SF-01)** to maintain a space temperature of 80°F (adjustable) during occupied and unoccupied modes.

3. SINGLE ZONE AHU WITH HUMIDITY CONTROL WITH DEMAND CONTROL VENTILATION AHU-01 & AHU-02

Equipment Control Points
Space temperature – AI
Cooling coil discharge temperature – AI
heating coil discharge temperature – AI
Space humidity – AI
Space CO2 – AI

Air flow piezo ring monitor through Transducer – AI (Quantity-Refer to AHU Schedule for Fan Quantity. BAS to provide transducer, wire and conduit to respective controller for each control point per fan.
Air handler fan status – current switch - DI
Chilled water valve - AO
Hot water valve - AO
Air handling unit fan start/stop - DO
Fan speed control – AO
Outside air damper – AO
Discharge air temperature – AI

AHU Activation
The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control
When the air handler is requested to run, the B.A.S. control module shall send signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable).There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required.

Each air handling unit shall be provided with a fan array consisting of (6) six individual fans, capable of maintaining 100% of design airflow with (1) one fan out of service (N-1 redundancy).
Upon an AHU start command, the BAS shall enable all (6) six fans. Fan speed shall be modulated simultaneously through the associated VFD to maintain the airflow requirements established by the temperature control sequence.

Each fan shall be provided with a factory-mounted piezometer (piezo) ring for individual fan airflow monitoring. The BAS subcontractor shall furnish and install an individual differential pressure transducer for each fan, connected to its respective piezo ring.

The BAS shall continuously monitor the individual fan airflow signals when the fan array is enabled. A fan failure shall be indicated when the airflow signal from an individual fan falls below an operator-adjustable minimum threshold while the fan is commanded to operate, following an adjustable time delay to prevent nuisance alarms. The threshold shall be coordinated with the fan manufacturer's airflow characteristics and minimum operating speed.

Upon detection of an individual fan failure, the BAS shall:

1. Generate an individual fan failure alarm at the BAS front end, identifying the failed fan via software pt.

2. Disable the failed fan and command its associated isolation damper closed, where provided.

3. Automatically increase the operating frequency of the remaining (5) five fans as required to maintain the original commanded airflow, up to 100% of design airflow.

4. Continue normal AHU temperature, humidity, and ventilation control without interrupting air handler operation, provided the remaining fans can maintain the required airflow.

5. Indicate N-1 fan array operation at the BAS front end.
   Upon detection of a second fan failure, the BAS shall generate an additional alarm indicating that the fan array has lost its required N-1 capacity. The remaining operational fans shall continue to operate at their maximum allowable speed determined by TAB Contractor, subject to equipment safety limitations, and the BAS shall generate an insufficient airflow alarm if the required airflow cannot be maintained.

Upon correction of a fan failure, the affected fan shall be permitted to return to normal operation following fault clearance, required reset, and verification of fan availability. The BAS shall gradually reduce the operating frequency of the remaining fans to restore normal six-fan operation without significant airflow fluctuation.

Fan Array Performance Requirements
The fan array manufacturer shall select and size the fan array to maintain 100% of scheduled design airflow at the specified system static pressure with either (6) six fans operating under normal conditions or (5) five fans operating under N-1 conditions.

Manufacturer's submittals shall document the required operating frequency (Hz), fan RPM, total airflow (CFM), static pressure, and motor brake horsepower (BHP) for both the six-fan and five-fan operating conditions at design airflow. The five-fan operating condition shall not exceed the maximum allowable fan speed, motor capacity, or VFD rating. All parameters are to be confirmed by TAB Contractor to ensure proper air flows are being met.

Temperature Control
A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Air Volume Demand Control Ventilation
When the air handler is running it the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO_2 sensor mounted in the return air or in the space, as indicated on drawings, shall monitor the CO_2 level. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO_2 level between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined by the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM. The B.A.S. shall select the highest level when more than one CO_2 sensor is used to modulate the damper. The system shall have the ability to perform a “Purge Mode” at a scheduled time for a scheduled duration. The outside air damper shall remain closed, during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Space Humidity Control
A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55^0F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the hot water reheat valve to maintain the space temperature between its heating and cooling setpoints. If the B.A.S. control module is receiving a broadcast from the HW system that heating water is not available (see Heating Water System sequence of operations) the chilled water valve shall not be overridden until heating water is available.

Unoccupied Control
If the space temperature reaches the operator adjustable unoccupied setpoints of 55^0F heating and 95^0F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

Associated Equipment
During the occupied time period, the outside air damper shall be open and/or a request to run shall be sent to the AHU that supply's its outside air. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed, and exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Equipment off Conditions
When the air-handling unit is de-energized, its chilled water valve, hot water valve, and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the AHU shall be canceled. While the units are off if the OA temperature falls below 34^0 F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the chilled and heating water pumps shall run for freeze protection.

4. PACKAGED 100% OUTSIDE AIR ROOFTOP UNITS WITH GAS HEAT
RTU-01, RTU-02, RTU-03 & RTU-04

All controls devices external to units shall be provided by the RTU manufacturer and installed by the control's contractor

The Rooftop units shall have a factory furnished controller with BACnet card. The BAS contractor shall furnish and install remote sensors and shall provide and install a BACnet interface and wiring. **The BAS contractor shall coordinate with the unit manufacturer to ensure device compatibility with factory controller and sequences of operation meet specifications and to also discover and incorporate all available control points. RTU manufacturer shall verify software provided with the factory controller matches sequences of operation. The RTU manufacturer and the BAS contractor shall both commission the unit and verify operation. RTU shall be able to have all equipment control points available via BAS and shall have read and write capability.**

The controls contractor is responsible for provide any additional wiring or conduit for external sensors to be mounted.

Equipment Control Points
Supply Air Temperature – AI
Supply Air Temperature Cooling & Heating Setpoints – (2) AO
Evaporator Coil Temperature – AI
Evaporator Coil Temperature Setpoint – AO
Fan Status – DI
Outside air damper – AO
DX Cooling Capacity – AI
Hot Gas Reheat Capacity – AI
Static pressure high limit - DI
Gas Heating Capacity – AI
Unit Start/Stop – DO (Hardwired to BAS)

Zone Occupancy
Each rooftop unit shall have an occupancy / vacancy schedule, occupied heating / cooling setpoints assigned to it by the BAS. Each rooftop unit shall be enabled by the BAS based on the programmed

occupancy schedule. When the unit is enabled, the outside air damper shall fully open, and the supply fan shall be enabled.

Fan Control
A fan airflow proving switch shall prove status to the unit controller and shall alarm at the central site if the switch is not made within 60 seconds.

Supply Air Temperature and Dew Point Control
The outside air temperature and relative humidity sensors shall control the unit mode of operation. When the outside air temperature is above 55°F, the unit shall be placed in dehumidification priority mode. During dehumidification priority mode, the refrigeration capacity shall modulate to maintain the evaporator coil temperature setpoint of 50°F (adj.), and the hot gas reheat valve shall be modulated to maintain the supply air temperature cooling setpoint of 68°F (adj.). When the outside air temperature is below 55°F, the unit shall be placed in heating mode. During heating mode, the natural gas heater shall modulate to maintain the supply air temperature heating setpoint of 72ºF (adj.).

Equipment off Conditions
When the unit is de-energized, the cooling and heating stages shall remain off and the outside air damper shall be fully closed.

5. FAN COIL UNITS WITH RE-HEAT COIL FOR HUMIDITY CONTROL
FCU-01, FCU-02 & FCU-03

Equipment Control Points
Space temperature – AI
Cooling coil discharge temperature – AI
heating coil discharge temperature – AI
Space humidity – AI
Fan status – DI
Auxiliary Drain Pan Switch - DI
Fan start/stop – DO
Chilled water valve control – AO
Re-heating water valve control – AO
OA damper control – DO

Zone Occupancy
The fan coil unit will have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program will calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The fan coil unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control
When the calculated start time arrives, the B.A.S. will send a signal to the fan coil unit starter and start the fan. A current switch will prove status to the B.A.S. and will alarm at the central site if the switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch.

Temperature Control
A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints.

Space Humidity Control

A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the hot water reheat valve to maintain the space temperature between its heating and cooling setpoints. If the B.A.S. control module is receiving a broadcast from the HW system that heating water is not available (see Heating Water System sequence of operations) the chilled water valve shall not be overridden until heating water is available.

Unoccupied Control

During the unoccupied time period if the space temperature reaches the unoccupied heating or cooling setpoints, the required equipment will be run to maintain the space temperature within the operator adjustable unoccupied setpoints of 55^0F heating and 95^0F cooling.

Associated Equipment

During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the FCU shall also be energized only during the occupied time period. The outside air dampers shall remain closed, the OAHU's and exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule. An auxiliary drain pan conductivity sensor will de-energize the unit upon sensing moisture in the drain pan. An alarm shall be sent to the BAS.

Equipment off Conditions

When the FCU is de-energized, its chilled water valve, hot water valve, and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled. While the units are off if the OA temperature falls below 34° F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the secondary pumps shall run for freeze protection.

6. DUCTLESS MINI-SPLIT-SYSTEM AIR CONDITIONERS (FCU-IDF-105 & FCU-ELEC-112)

The split systems shall have a factory furnished controller and operate stand-alone based on unit thermostat. The BAS shall monitor the space temp only. Thermostat provided by unit manufacturer and installed by BAS.

Equipment Control Points

Space Temperature – AI (monitoring only)

7. GENERAL EXHAUST FANS – EF-01

Equipment Control Points

Fan status – Current switch - DI
Fan start/stop – DO

Interlock exhaust fans to run with **RTU-04** serving the same area and run when the RTU is operating in the occupied mode with their OA Dampers open. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule.

8. BOILER ROOM SUPPLY FAN - SF-01

The fans shall be wired to operate continuously. The BAS shall monitor status via current sensing relay. If fan stops, as sensed by current switch, the BAS shall alarm the operator.

9. CARBON MONOXIDE MONITORING – HVAC BOILERS

Carbon Monoxide Monitoring
A carbon monoxide sensor installed in the boiler room will alarm the BAS and shut down the boiler(s). The BAS shall notify Pearland Facility Maintenance personnel via e-mail and text message when the level of carbon monoxide rises above 100 ppm (adjustable). The sensor shall also alarm the BAS and shutdown the boiler upon loss of power to the sensor. A strobe light and audible alarm at the panel will be activated during an event. A push button on the panel will silence the alarm and reset the system. Carbon monoxide sensor shall be calibrated every eighteen months and a record of calibration shall be posted in a conspicuous place.

10. VARIABLE SPEED DRIVES INTERFACE

Equipment Control Points
Start/stop – DO
Alarm – DI
Last fault – AI
Reset – DO
% Output – AI
Frequency output – AI
Speed – AI
Current – AI
Power – AI
Drive temperature – AI
KWh – AI
Runtime - AI

The BAS shall interface directly to each variable speed drive and report all information to the central site.

11. OUTSIDE AIR INTAKE DAMPER ACTUATORS
AHU-01 & AHU-02, RTU-01, RTU-02, RTU-03 & RTU-04

When the associated Air Handling Unit is in occupied mode, the BAS controller shall open the outside air damper. Actuators, wiring and installation by BAS.

12. BUILDING RELIEF LOUVERS (TYPICAL FOR 4)

The BAS shall OPEN each motorized relief damper when the associated area is occupied. An internal Barometric damper shall OPEN/ CLOSE according to interior building air pressure.

Damper and actuators provided and installed by BAS.

In the event of a Shelter in Place shutdown all motorized Relief dampers shall be CLOSED.

13. ELECTRIC UNIT HEATERS
EUH-01 & EUH-02

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

Enable – DO
Status – DI

The end-user shall have the ability to disable electric heaters, so as not not be controlled enabled by the stand-alone thermostat during unoccupied hours for energy savings.

14. OUTDOOR AIR CONDITIONS

Equipment Control Points
Outdoor air temperature – AI
Outdoor air humidity – AI

National Weather Service – BACnet Data Collection via Internet
The sensors shall be mounted in an area on the north side of the building where the representative temperature and humidity can be monitored, both shall have sun shields. Based on the outside air temperature and humidity the BAS shall calculate the outdoor enthalpy, wet bulb, and dew point temperatures. The outdoor air temperature and humidity shall be broadcast as global information for use by the other control programs.

Programming may be utilized to provide the main data for the outdoor air conditions via the internet. The National Weather Service weather station nearest to the location will be used to broadcast the primary outdoor air conditions as global information for use by the other control programs. The sensors mounted in the north side of the building will provide backup or secondary weather information

15. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

16. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

17. LOAD SHEDDING

Energy Demand Control
The system will allow the user to schedule one of three demand level zone temperature set points. The user will also be able to shut down outside air and exhaust either during the same period or during a separately scheduled period. The scheduled action (Demand Control Event) will apply to an entire building or group of buildings. The Demand Control Event can also be initiated immediately for a user adjustable period of time. The amount of temperature adjustment can be varied for individually controlled zones. Individually controlled zones and equipment can also be excluded from Demand Control Events. If an energy meter is used, the system will also allow the temperature set point adjustments to be triggered when certain energy consumption thresholds are exceeded. The thresholds can be adjusted for six different user selectable time periods during the day. A control Dashboard is provided in the BAS software to manage and schedule Demand Control Events. From the Dashboard, allowed actions can be enabled or disabled when the Event occurs for each site under control.

Optional – The user may also choose to engage additional Demand Control Actions which include Chiller State Control, VFD Speed Limit, Special Zones, and Zone Shutdown.

- Chiller State Control will impose a limit to and/or reduce Chiller Plant capacity or shut down all chillers.

- VFD Speed Limit will impose a maximum speed limit allowed to VFD controlled devices, by applying a percentage multiplier to the PID control loop output.

- Special Zones will allow a group of zones to be excluded from the Demand Control Event.

- Zone Shutdown will allow groups of zones to be sequentially shut down by placing them in Un-occupied mode. The user can select the maximum number of groups that can be concurrently shut down and the maximum time any one group can be shut down. Up to eight (8) groups can be used. If an energy meter is used, this feature can also use a Load Shedding Target value to increase or decrease the number of concurrent groups that are shut down.

BAS provider will add the Set-point Adjust, Outside Air Shutdown, Chiller State Control, VSD Limit, Special Zone, and Zone Shutdown features to selected sites, as listed below. These features can be managed with a single or multiple hierarchal dashboards which are intended to provide centralized control of Electrical Demand Curtailment measures. It is also possible to trigger the Demand Curtailment measures with either a schedule or manually for a selected amount of time.

- Set-point Adjust - can trigger one of three zone temperature set-point adjustments.

- Outside Air Shutdown - will disable outside air dampers and/or fans as well as associated exhaust fans.

- Chiller State Control - allows the chiller manager program to apply a limit to the maximum state allowed. This can have the effect of reducing the number of running chillers or shutting down the chillers if desired.

- VSD Limit - will enable an adjustable percentage multiplier to be applied to the controlled fan speed and secondary chilled water pump speed settings at the listed locations and the applicable programs that have fan speed and secondary chilled water pump speed control.

- Special Zones - will allow a group of zones, such as admin and gym areas to be excluded or included in the Demand Curtailment Event. This will allow the special zones to be excluded during the summer partial occupancy periods but included during utility Demand Events.

- Zone Shutdown - will allow groups of zones to be sequentially shut down by placing them in Un-occupied mode. The user can select the maximum number of groups that can be concurrently shut down and the maximum time any one group can be shut down. Up to eight (8) groups can be used. If an energy meter is used, this feature can also use a Load Shedding Target value to increase or decrease the number of concurrent groups that are shut down.

- The Dashboard(s) include the ability to enable/disable the Set-point Adjust and/or Outside Air Shutdown feature at each site. The Set-point and Outside Air features can be scheduled simultaneously or separately. If a site has an electric metering device collecting data by the WebCTRL system, that data will be listed and totalized on the Dashboard.

- The main graphic page for each site listed will also be modified to include an indicator that displays the current Demand Level and Outside Air Status for that site.

- A Pre-Cool Feature is also included at selected sites. This allows zone set-points to be lowered before a demand event, thereby extending the demand reduction period, and reducing the impact on occupants.

- The customer must review chiller sequence settings at all affected sites, such as state selection and load percentages to achieve maximum benefit. Demand Based Differential Pressure Reset is incorporated in most programs controlling VSD's. The customer should also review these settings.

- The customer will inform BAS provider of any AHU's, Exhaust Fans and/or Dampers for Outside Air that will have adverse effects on equipment or building pressures, so that these items can be excluded from the Outside Air Shutdown sequence

18. HVAC TIMED LOCAL OVERRIDE (TLO)

A local override button located as directed by the owner shall allow temporary override of the entire system. Each press of the button shall place the system in occupied mode for 30 minutes (adjustable), to a maximum of 2 hours (adjustable).

19. EMERGENCY SHUTDOWN (SHELTER-IN-PLACE)

Equipment Control Points
Shutdown switch status – dry contact – DI

Provide a single mushroom style, maintained operation pushbutton. Locate button as directed by owner. Provide clear plastic cover to prevent accidental activation. Provide engraved identification tag with "Emergency HVAC Shutdown". When activated, the BAS shall shut down the HVAC system and close all intake, exhaust, and relief dampers.

20. LIGHTING CONTROL (INTERIOR & EXTERIOR)

Equipment Control Points
Lights on/off – DO (Refer to electrical drawings for quantities and locations)
Photocell – AI

Lighting Control
The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for and adjustable time period before or after sunrise.

Override
Provide a method of manual override in an easily accessible location (i.e., control relay with integral hand-off-auto in control panel).

Interior
The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator.

Override

The BAS is to provide a hardwired point (aux contact) to the security panel so if security is activated/deactivated the BAS will be overridden. Through the contact the BAS shall monitor the security panel mode (on/off) in order for operator to know if the lights are overridden.

21. PLUG LOAD CONTACTORS

Equipment Control Points
Contactors on/off – DO (Refer to electrical drawings for quantities and locations)

Plug load contactors as indicated on plans shall be schedulable by the BAS.

22. LIGHTING TIMED LOCAL OVERRIDE (TLO)

Equipment Control Points
Override button input – DI

A local override button located as directed by owner shall allow temporary override of the interior lighting. Each press of the button shall override the system for 30 minutes (adjustable), to a maximum of 90 minutes (adjustable).

23. POWER MONITORING

Equipment Control Points
KW input – From Switchgear – BACnet Interface

The BAS shall connect to building electrical meter and monitor the buildings KWH usage. The B.A.S. control module shall show the current usage, monthly usage, year-to-date usage, and time and date of the highest peak demand for the month and year. Demand thresholds may be set to adjust set-points and shed loads in order to reduce peak consumption.

Sub Metering
The BAS shall interface to the sub meters provided and installed by the electrical contractor via BACnet MSTP protocol. Refer to electrical drawings for sub meter quantities and location. Display all available information at the BAS.

Alarming
The BAS shall provide alarm capabilities when power outages occur. All equipment necessary to accomplish sending alarms via email or text shall be on emergency power.

24. DOMESTIC WATER HEATER

Equipment Control Points
CO Monitoring Alarm – DI

Carbon Monoxide Monitoring
A carbon monoxide space sensor will alarm the BAS and shut down the domestic water heater and notify district maintenance personnel via e-mail and text message when the level of carbon monoxide rises above 100 ppm. The sensor shall also alarm the BAS and shut down the water heater upon loss of power to the sensor. A strobe light and audible alarm at the panel will be activated during an event. A push button on the panel will silence the alarm and reset the system. Carbon monoxide sensor shall be calibrated every eighteen months and a record of calibration shall be posted in a conspicuous place.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot water heating piping.
2. Chilled water piping.
3. Make-up water piping.
4. Condensate-drain piping.
5. Blowdown drain piping.
6. Air-vent piping.

B. Related Sections include the following:

1. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for Hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.5 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.

B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.

C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.6 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.

2. RTRP and RTRF with adhesive.

3. Pressure-seal fittings.

C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. The Pipe shop drawings shall be superimposed on the architectural backgrounds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control test reports.

C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.

E. Test Reports: Indicate results of refrigerant leak test and acid test.

F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.8 QUALITY ASSURANCE

A. All pipe and accessories shall be of United States domestic manufacture.

B. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.

G. Maintain one copy of each document on site.

H. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Division 1 - General Requirements.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.

D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.10 WELDING

A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and “Standard Qualifications for Welding Procedures, Welders and Welding Operators."

B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.

C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type B).

B. Wrought-Copper Fittings: ASME B16.22.

1. Housing: Ductile Iron.
2. Gasket: EPDM, Grade EHP
3. Pipe Sizes 2” and larger
4. Tools: Manufacturer's grooving tools.
5. Minimum 300-psig working-pressure rating at 250 deg F.

C. Copper or Bronze Pressure-Seal Fittings:

1. Housing: Copper.
2. O-Rings and Pipe Stops: EPDM.
3. Pipe Sizes 2” and down
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends; application as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.

D. Malleable-Iron Unions: ASME B16.39; Classes 150.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 250.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings; ASTM F 439 for Schedule 80 pipe.

C. PVC Plastic Pipe: ASTM D 1785, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.

D. PVC Plastic Pipe Fittings: Socket-type pipe fitting; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.

2. CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.

2. MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Jomar International Ltd.
   e. Matco-Norca, Inc.
   f. McDonald, A. Y. Mfg. Co.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   h. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 150 psig minimum at 180 deg F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Matco-Norca, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 150 psig minimum at 180 deg F.
   d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Description:

   a. Non-conducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig.
   c. Gasket: Neoprene or Phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elster Perfection.
   b. Matco-Norca, Inc.
   c. Precision Plumbing Products, Inc.
   d. Victaulic Company.

2. Description:

   a. Standard: IAPMO PS 66
   b. Electroplated steel nipple. Complying with ASTM F 1545.
   c. Pressure Rating: 300 psig 225 deg F.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot water heating and chilled water above ground, NPS 2 and smaller, shall be the following:

1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot water heating and chilled water above ground, NPS 2-1/2 and larger, shall be one of the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Makeup-water piping installed aboveground shall be the following:

1. ASTM B 88, Type K (ASTM B 88M, Type B) drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

D. Condensate-Drain Piping: ASTM B 88, Type L (ASTM B 88M, Type B) hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow-down drain is installed.

F. Air-Vent Piping:

1. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. All piping (hot and chilled) shall be painted 18 inches minimum at all terminations at chillers, pumps, and air handling units before insulation is installed. Paint shall be rust inhibiting or galvanizing type.

C. All equipment shall be installed for serviceability with a minimum of 36” clearance or additional clearance as required by code or equipment manufacturer. All service doors shall be able to fully swing open without any obstruction such as but not limited to piping, duct, walls, etc.

D. All chilled and heating water piping taps shall be off of the top of the water lines. No side or bottom taps shall be acceptable.

E. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping to permit valve servicing.

I. Install piping at indicated slopes.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install piping to allow application of insulation.

M. Select system components with pressure rating equal to or greater than system operating pressure.

N. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

O. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

P. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

Q. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

R. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

S. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."

T. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

U. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

V. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

W. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."

X. Install lateral bracing with pipe hangers and supports to prevent swaying.

Y. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

Z. Install sleeves for piping penetrations of walls, ceilings, and floors.

AA. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Section 23 05 29 - “Hangers and Supports for HVAC Piping and Equipment”.

BB. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 – “Hangers and Supports for HVAC Piping and Equipment”.

CC. Provide access doors where valves and fittings are not accessible.

DD. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

EE. Provide unions or flanges and isolation valves at each connection to a piece of equipment or control valve; accessory which requires removal for maintenance. Screwed unions should be used for two (2) inches IPS and smaller. Locate joints where they can be accessed for repair. Screw or flanged joints shall not be permitted above inaccessible ceilings or in chases.

FF. All piping shall be installed to eliminate traps and pockets. Where air pockets or water trap cannot be avoided, provide means for drainage with valved hose connections for water trap and air vents for air pockets. Provide drain valves at low points of the system.

GG. For pipe inside building, install parallel to lines of building, close to columns and walls vertical pipe shall be truly vertical. Spring or forcing piping into place will not be permitted. Install pipe to prevent strain on equipment connections.

HH. Provide adequate access to all equipment, motorized valves, instruments, controls, and access panels.

II. Allow easy draining of water piping, with drain valves at low points.

3.3 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.

4. PVC Non-pressure Piping: Join according to ASTM D 2855.

K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.4 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

3.5 FIELD QUALITY CONTROL

A. Prepare Hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, un-insulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush Hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on Hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that Hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least one hour, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of Hydronic equipment, such as boilers, chillers, cooling towers, to specified values.

7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Horizontal Split-Case Pump.
2. Pump Suction Diffusers.

B. Related Sections:

1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment - Mechanical Vibration Control: Product requirements for vibration isolators required with pumps.

1.3 REFERENCES

A. Underwriters Laboratories Inc.:

1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

A. Provide pumps electrical characteristics in accordance with Division 26 and schedules on Drawings.

1.5 SUBMITTALS

A. Submit in accordance with Division 1 and Section 23 05 00.

B. Provide line-by-line specification review annotated to certify compliance or deviation.

C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Provide parallel pump curves indicating the non-overloaded motor horsepower for single pump operation when applicable. Include NPSH curve with operating point plotted when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

D. Shop Drawings: For each pump.

1. Show pump layout and connections.

2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

EQUIPMENT SHALL BID AS AN ALTERNATE

3. Include diagrams for power, signal, and control wiring.

E. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1, General Requirements.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 WARRANTY

A. Furnish one (1) year manufacturer parts and labor warranty for pumps. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.

1. Furnish one (1) set of mechanical seals for each pump installed.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Pumps shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to

EQUIPMENT SHALL BID AS AN ALTERNATE

the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 PUMP IDENTIFACTION REQUIREMENTS

A. Furnish each pump with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Flow rate (GPM) and head (ft. H20).
- Motor Horsepower.
- RPM
- Power Supply: Volts / PH / Amps.
- Sales Order #.
- Date of unit manufactured.

B. For chilled water pumps, in addition to the base mounted identification tag provide an additional identification tag shipped loose for contractor to install on external rigid insulation board.

PART 2 – PRODUCTS

2.1 HORIZONTAL SPLIT CASE BASE MOUNTED PUMPS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. Description: Factory-assembled and tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump; designed for base mounting, with pump and motor shafts horizontal.

C. Casing: Horizontally split, cast iron, with replaceable bronze wear rings, threaded gage tapping's at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class 125. Casing supports shall allow removal and replacement of impeller without disconnecting piping.

EQUIPMENT SHALL BID AS AN ALTERNATE

D. Impeller: 304 stainless steel statically and dynamically balanced, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.

E. Bearings: Grease or permanently lubricated roller or ball bearings. Bearings shall have 40,000-hour minimum life.

F. Shaft: 420 stainless steel with stainless steel shaft sleeve.

G. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.

H. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor.[EPDM coupling sleeve for variable-speed applications.

I. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

J. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

K. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

a. Enclosure: Outdoors: Totally enclosed, fan-cooled (TEFC).
b. Enclosure: Indoors: Open Drip Proof (ODP).
c. Efficiency: Premium efficient.
d. NEMA Design: MG-1.
e. Service Factor: 1.15.

2.2 PUMP SUCTION DIFFUSERS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Bell and Gossett
2. Pentair / Aurora
3. Taco
4. Armstrong

B. Angle pattern, with flanged outlet and inlet connections; grooved connections shall not be acceptable.

C. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.

D. Removable stainless steel fine mesh startup and 1/8” perforated stainless-steel star shaped permanent strainers.

E. Stainless-steel straightening guide vanes.

EQUIPMENT SHALL BID AS AN ALTERNATE

F. Drain plug, blow-down tapping in bottom, gage tapping on side.

G. Factory-fabricated adjustable foot support.

H. Permanent magnet located in flow stream removable for cleaning.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping

D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct bases to withstand, without damage to equipment, seismic force required by code.

3. Construct concrete bases 4 high and extend base not less than 6 inches in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.

4. Install base mounted pumps on concrete inertia base “RBMK” with spring isolators. Refer to section 23 05 48.

EQUIPMENT SHALL BID AS AN ALTERNATE

E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

F. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.

G. Provide air cock and drain connection on horizontal pump casings.

H. Provide drains for bases and seals. Route to floor drain.

I. Lubricate pumps before start-up according to manufacturer’s instructions.

3.3 REQUIRED ALIGNMENT – APPLIES TO ALL BASE-MOUNTED PUMPS

A. Alignment Service shall be performed by a factory authorized direct service technician. Alignment work shall not be performed by installing mechanical contractor.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout is cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater diameter of pump nozzles.

E. Discharge side of pumps install flexible connector for end-suction pumps, non-slam check valve, combination shut-off butterfly valve and throttling valve with memory stop, and thermometer.

EQUIPMENT SHALL BID AS AN ALTERNATE

F. Suction side of pumps install suction diffuser with type 304 stainless steel strainer, flexible pipe connector for end-suction pumps shut-off butterfly valve on suction side of pumps and thermometer.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

3.5 STARTUP SERVICE

A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.

1. Complete installation and startup checks according to manufacturer's written instructions.

a. Check piping connections for tightness.

b. Clean strainers on suction piping.

c. Perform the following startup checks for each pump before starting:

1. Verify bearing lubrication.

2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

3. Verify that pump is rotating in the correct direction.

d. Prime pump by opening suction valves and closing drains and prepare pump for operation.

e. Start motor.

f. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.

1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

2. Provide documentation of owner training in close out submittal.

END OF SECTION 23 21 23

SECTION 23 25 13 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

B. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

C. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.4 DESCRIPTION OF WORK

A. Work Included: Perform water analysis and provide all water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:

1. Chilled Water Systems
2. Heating Water Systems

B. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for three months after acceptance by the Owner.

C. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.

D. Testing Equipment and Reagents: Furnish suitable water treatment equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three months after acceptance by the Owner.

E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems and tests required. Service representative shall return to the site bi-weekly during first 2 months of operation and monthly during the remainder of the guarantee period. At such time, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.

F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to the Owner for 1 year after successful start-up of the system. All warranty work shall be FOB as installed at the project site.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.

2. Agreement to Maintain: Provide system produced by manufacturer who is willing to execute (with the Owner) the required agreement for continued maintenance of the system.

1.5 QUALITY ASSURANCE

A. Qualifications: The Contractor for work under this Section shall have:

1. Research and development facilities.

2. Regional laboratories capable of making water analysis.

3. A service department and qualified technical service representative located within a reasonable distance of the project site.

4. Service representatives who are Registered Engineers of factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.

B. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Use only chemicals in domestic water systems, all coincides regardless of where used, which are registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and which are labeled as required by law.

C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.

D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

1.6 SUBMITTALS

A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.

B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, piping, and tubing sizes, fittings, accessories, valves and connections.

C. Guarantee: Submit written guarantee signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required achieving the required performance, during a 1-year period following the final start-up or the continued operation of the chillers.

D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four copies of an "Agreement for Continued Service and the Owner's possible acceptance." Offer terms and conditions for furnishings chemicals and providing continued testing and equipment for a 1-year period with option for renewal of the Agreement by Owner.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Chem-Aqua

2.2 GENERAL

A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.

B. **Pre-Treatment: For Flushing and Cleaning of Hydronic Piping, refer to specification section 23 25 19. Flushing and Cleaning of Hydronic Piping shall be performed by a third party hired by the General Contractor and shall not be performed by the installing mechanical subcontractor.**

C. FDA and USDA Approval: use only FDA and USDA-approved products in system with direct connection to domestic water systems.

D. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

2.3 CHILLED AND HEATING WATER SYSTEMS

A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:

1. Form a protective film to prevent corrosion and scale formation to maintain iron levels between 0.0 and 0.5 as Fe.

2. Scavenge oxygen and protect against scale

3. Remain stable throughout operating temperature range

4. Are compatible with pump seals and other elements in the system.

5. For aluminum condensing boilers, molybate at 10 to 25 ppm and maintain pH limit below 8.5; refer to boiler manufacturer's recommendation.

6. Chilled Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 650 to 750 ppm as NO_2 (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.

7. Heating Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 750 to 1,000 ppm as NO_2 (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.

B. Equipment: Provide a bypass feeder with a 5-gallon capacity. The feeder shall be constructed of 10-gauge steel and impervious to the products dispensed. Tank heads shall have a minimum of 9-gauge steel and shall be rated at 300 psi and to 200°F. Chemical feeder shall have inlet and outlet drain valves with full bottom drain. The tank

shall have a wide mouth, 3-1/2” opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. Closures rated less than 300 psi shall not be considered equal.

The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. Closures using “o” rings or gaskets which are glued or restrained from free movement by snap rings shall not be considered equal.

Provide bypass feeder with legs to elevate the feeder off of the floor. The legs shall have holes to allow mounting to anchor bolts.

The bypass feeder shall be provided with a 5-micron filter bag fully supported by a stainless-steel filter basket for simultaneous side stream filtering.

1. Acceptable Manufacturer: Neptune, model FTF-5DB.

C. Test Kit: Provide test kit and reagents for determining proper water conditions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.

B. Testing: Perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

3.2 FLUSHING:

A. Drain preparation and boil out products from the systems. Flush with clean water until system tests prove systems are free of preparation and boil out products and other contaminants prior to administering system water treatment as specified hereinbefore.

3.3 CHILLED AND HEATING WATER SYSTEM:

A. Treatment: Treat initial water charge to chilled water loop at 650-750 ppm as NO_2 and heating water loop at 750 to 1000 as NO_2 water systems, after system has been flushed and prepped, to achieve a water quality as specified.

B. Start-up Procedures: During chilled and heating water system start-up, operate chilled and heating water treating systems (after charging with specified chemicals) to maintain the required steady-state characteristics of cooling and heating water. Demonstrate system operation to Owner's operating personnel.

C. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:

1. D 859 - Tests for Silica in Water and Water Waste

2.	D	1067	-	Tests for Acidity or Alkalinity of Water
3.	D	1068	-	Tests for Iron in Water and Wastewater
4.	D	1126	-	Tests for Hardness in Water
5.	D	1128	-	Tests for Identification of Types of Microorganisms and Microscopic Matter in Water and Wastewater
6.	D	3370	-	Sampling Water

D. Water Chemistry: Where water chemistry substantiates that pH is not necessary, chemical fee shall be based on water makeup qualities. Water analysis shall be based on the full parameters of operation, and all possible water supplies. Total hardness and "M" alkalinity of the makeup water will be the determining factor along with the technical limitations of the inhibitors.

3.4 PERSONNEL TRAINING:

A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water treating systems including preparation of chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

END OF SECTION 23 25 13

SECTION 23 25 19 – FLUSHING AND CLEANING OF HYDRONIC PIPING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

C. Professional Flushing and Cleaning subcontractor shall bid work specified under this section direct to General Contractor. Flushing and Cleaning subcontractor shall not be hired by mechanical contractor or any sub-contractor.

1.3 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section shall have a minimum three (3) year's experience. Provide resume within action submittals of personnel.

1.4 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries.

1.5 DESCRIPTION OF WORK

A. Work Included: Perform water analysis and provide all water cleaning products, holding reservoirs, equipment and labor for cleaning, and flushing to control water quality for each system.

B. Testing Equipment and Reagents: Furnish suitable water flushing and cleaning equipment for each system, complete with apparatus and reagents necessary.

1.6 QUALITY ASSURANCE

A. Qualifications: The Contractor for work under this Section shall have:

1. A service department and qualified technical service representative located within a reasonable distance of the project site.

1.7 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Provide complete flush plan utilizing mechanical scaled drawings at ¼" = 1'-0" indicating flow groups, bypass locations, velocity (fps), flow, etc.

C. Submit:

1. List of current experience and completed experience.
2. Resumes of Personnel:

a. Project Manager
b. Superintendent
c. Assistant Superintendent
d. Project Engineer, etc.

1.8 CLOSEOUT SUBMITTALS

A. Test reports: Submit test reports certified by an officer of the firm on company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.

B. Provide flushing logs indicating the following:

1. Date and time when flushing begins and ends.
2. Date and time of initial chemical addition to the system.
3. Date, time, and duration of any temporary stoppage.
4. Periodic test results showing chemical concentration by pH or conductivity.
5. Flow rate at each pump.

PART 2 – PRODUCTS

2.1 PROFESSIONAL FLUSHING AND CLEANING SERVICES PERFORMED BY:

A. A third-party flushing company will be used for flushing and cleaning of the HVAC related piping. Flushing shall not be performed by the installing mechanical contractor.

B. Flushing and cleaning services work specified under this section shall bid direct to the General Contractor. Flushing and Cleaning contractor shall not be hired by mechanical contractor or any sub-contractor.

C. General contractor is responsible for coordinating work with the Flush and Cleaning Contractor, Mechanical Contractor, and Chemical Treatment Provider. Subcontractor requirements are specified herein.

<u>Mechanical Contractor</u>:

- On site support when Flushing and Cleaning Contractor is on site, including 24 hrs. as applicable during flushing.
- Monitor integrity of installed piping and address any identified issues (e.g. leaks).
- Operate system valves as required to follow flushing procedure.
- Blow down all low points and dead legs every 6 hours during all flushing stages.
- Ensure any unidirectional or flow limiting components (i.e. check valves, control valves) can pass the indicated flowrates in the direction shown on the drawings. If not possible, these components must be either bypassed or removed.
- Verify portable ultrasonic flow meter settings as needed for General Contractor (GC) / Client approval.

<u>Mechanical Contractor / Chemical Treatment Provider</u>:

- Provide SDS sheets for all chemicals.
- Perform all transferring and metering of chemicals from storage containers into Flushing and Cleaning providers equipment for application into the project system.
- Perform water quality measurements during all flush stages and use them to direct the timing of the following:

    - Completion of the Clear Water Flush stage.
    - Start of the Cleaning / Passivation stage timer.
    - Completion of the Rinse stage.
    - Start of the Layup timer.

2.2 GENERAL

A. Pre-Treatment: For new construction and/or renovations to existing hydronic systems, flush and clean all hydronic piping systems to remove and permit flushing of mill scale, oil, grease and other foreign matter. A school district supervisor is to be present to observe cleaning of hydronic piping systems. Systems shall not be started up until the piping has been cleaned.

2.3 FLUSHING AND CLEANING OF STEEL PIPING SYSTEM:

A. After the mechanical contractor has pressure tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the closed loop chilled and hot water systems as specified herein. Systems must be commissioned as clean and meet water treatment specifications.

B. All chilled and hot water piping and related equipment shall be thoroughly flushed out with pre- cleaning chemicals designed to remove deposits such as pipe dope, oils, loose rust, mill scale and other extraneous materials. Recommended dosages of pre-cleaner chemical products shall be furnished by water treatment supplier, added and circulated throughout the water systems. The water system shall then be diluted and final flushed thoroughly until no foreign matter is observed and total alkalinity of the water is equal to or better that that of the make-up water.

C. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at each coil and heat exchanger during the flushing and cleaning operation.

D. Self-contained flush unit requirements will contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.

E. Flushing Procedure Guidelines:

1. Pre-flush: Bypass loops should be installed in front of any strainers and control valves at all equipment components. Coordinate with PurgeRite for proper sizing and placement of bypasses and flush ports.

2. Install temporary strainer elements in front of pumps, tanks, solenoid valves, control valves, and other equipment where permanent strainers are not indicated that are not

bypassed. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow-off valve. Strainers should be removed when a self-contained flush unit is used in conjunction with on board filtration.

3. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush process. A water dump location should be identified which as well is usually the sanitary.

F. Clear Water Flush

1. Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 -7 ft. /sec throughout. Filtration should be at minimum, 50 microns. This flush shall continue until the system water is comparable to the make-up water. Iron content should be under 2.0 ppm.

G. Cleaning & Passivation

1. The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft. /sec throughout, and the circulation time will be based on the chemical testing, but will be at minimum, 24 hours.

H. Final Clear Water Flush

1. The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing treated water is being discharged, a freshwater make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron meets specifications. The final system water should be approved by the chemical treatment company. Filtration should be 5 microns.

I. Final Chemical Fill

1. Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important the water not be left stagnant.

2. Verify satisfactory completion of clean piping and a final flushing and chemical treatment report should be submitted by field personnel. The report should include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

3. Cleaning chemicals, procedure, water testing, reporting, and consultation must be provided by a qualified water treatment company specializing in this type of work.

2.4 FLUSHING AND CLEANING OF PEX, POLYPROPYLENE, OR HDPE PIPING SYSTEMS:

A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the piping as specified herein. Systems must be commissioned as clean.

B. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at any equipment or building during the flushing and cleaning operation.

C. Self-contained flush unit requirements should contain a pump or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.

D. Flushing Procedure Guidelines

1. Pre- Flush:

   Bypass loops should be installed at all equipment or building components. Strainers should be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush.

2. Clear Water Flush:

   Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 – 7 ft. /sec throughout. Filtration should be at minimum, 5 microns. Minimum duration should be calculated using a formula of 1 hour per 1000’ of linear pipe and until system water is comparable to make up water source. The minimum circulation time should be 1 hour regardless of the length.

3. Final Chemical Fill

   Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system if required. Once the system is filled with the final chemicals it is important the water is not left stagnant and to mix chemicals.

   Verify satisfactory completion of clean piping and a final flushing report will be submitted by field personnel. The report will include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.

B. Testing: Perform test procedures and submit a written final report (at each phase if applicable) of test conditions and results to the Contractor and Consulting Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

END OF SECTION 23 25 19

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and Flat Oval ducts and fittings.
3. Double-wall rectangular ducts and fittings.
4. Double-wall round and Flat Oval ducts and fittings.
5. Double-wall flat oval / round / rectangular outdoor ductwork.
6. Insulated Flexible Ducts
7. Sheet metal materials.
8. Sealants and gaskets.
9. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

3. Division 23 Section “Duct Insulation” for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: For each type of the following products:

1. Adhesives.
2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.

3. ¼" = 1'-0" Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.

4. Dimensions of main duct runs from building grid lines.

5. Fittings.

6. Reinforcement and spacing.

7. Seam and joint construction.

8. Penetrations through fire-rated and other partitions.

9. Equipment installation based on equipment being used on Project.

10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.

2. Suspended ceiling components.

3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.

6. Items penetrating finished ceiling including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Titan Metals
7. Telkin Sheetmetal, Inc.
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. McGill AirFlow LLC.
13. Texas Air Duct Systems
14. SEMCO Incorporated
15. Lindab Inc.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. Sheet Metal Connectors, Inc

D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Titan Metals
7. Telkin Sheetmetal, Inc.
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. McGill AirFlow LLC.
13. Texas Air Duct Systems
14. SEMCO Incorporated
15. Lindab Inc.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Titan Metals
7. Telkin Sheetmetal, Inc.
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. McGill AirFlow LLC.
13. Texas Air Duct Systems
14. SEMCO Incorporated
15. Lindab Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg. F mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg. F mean temperature.

H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Titan Metals
7. Telkin Sheetmetal, Inc.
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal
12. McGill AirFlow LLC.
13. Texas Air Duct Systems
14. SEMCO Incorporated
15. Lindab Inc.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

   b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg F mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: K = 0.23 at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Envirotech Mechanical Systems
2. Gurry Mechanical L.P.
3. Letsos Company
4. Mason Road Sheet Metal Inc.
5. McCorvey Sheet Metal Works
6. Titan Metals
7. Telkin Sheetmetal, Inc.
8. Tomball Sheet Metal Co.
9. MLN
10. Walsh & Albert
11. Grant Sheet Metal

12. McGill AirFlow LLC.
13. Texas Air Duct Systems
14. SEMCO Incorporated
15. Lindab Inc.
16. Linx.

B. Fabricate ducts with indicated dimensions for the inner duct.

C. Material:

1. Outer Duct: 18-gauge epoxy coated galvanized duct.

2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.

D. Inner Duct: 20 gauge perforated galvanized duct.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.

1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.

F. Exterior Coating / Finish.

1. Epoxy coated exterior duct.

2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.

3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thermaflex Type M-KE.
b. Atco

B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.

a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
b. Maximum Velocity: 4,000 fpm.
c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
d. Thermal Resistance: Minimum R-6 installed.
e. Maximum flexible duct length shall not exceed 5'-0".

C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to “23 33 00 Air Duct Accessories”; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.

E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

I. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts

and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent, or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8” relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer’s instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 DUCT STORAGE / CLEANING

A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4” above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not “dried-in”. If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.

B. The working area shall be clean; dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria’s, Libraries, etc.: Double wall insulated round ductwork.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive 1-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 24.
    d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:

    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round: 6.

3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:

    a. Pressure Class: Positive 4-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 6.
    d. SMACNA Leakage Class for Round: 3.

C. Return and Outside Air Ducts:

1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive or negative 1-inch wg.
    b. Minimum SMACNA Seal Class: C.
    c. SMACNA Leakage Class for Rectangular: 24.
    d. SMACNA Leakage Class for Round: 12.

2. Ducts Connected to Air-Handling and Rooftop Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: B.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

    a. Pressure Class: Negative 1-inch wg.
    b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 12.
    d. SMACNA Leakage Class for Round: 6.

2. Ducts Connected to Air-Handling and Rooftop Units:

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    c. SMACNA Leakage Class for Rectangular: 12.

d. SMACNA Leakage Class for Round: 6.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.

b. Not Exposed to Airstream: Match duct material.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1. Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1,000 fpm or Lower: 90-degree tap.
b. Velocity 1,000 to 1,500 fpm: Conical tap.

c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 31 18- FABRIC DUCT

PART 1-GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK

A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.

B. Types of non-metal ductwork required for this project include the following:

1. Fabric Air Dispersion Products suitable for Natatoriums and Gymnasiums.

1.3. QUALITY ASSURANCE

A. Building Codes and Standards:

1. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and UL 2518.

2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.

B. Design & Quality Control

1. Manufacturer must have documented design support information including duct sizing; vent, orifice, and/or nozzle location; vent, orifice, and/or nozzle sizing; length; and suspension. Parameters for design, including maximum air temperature, velocity, pressure and textile permeability, shall be considered and documented.

2. Manufacturer's Environmental Product Declaration (EPD) must be inclusive of the following:

a. Fabric.
b. Cutting, sewing, processing of DuctSox.
c. Zippers.
d. Metal suspension system parts and framework (if applicable).
e. Energy, water, recycled & waste of plant processing fabric & suspension.
f. Complete packaging including boxes, bags & staples.
g. Transportation.

1.4. SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.

C. Building Code Data: Submit UL file number under which product is Classified by Underwriter's Laboratories for both NFPA 90-A and UL 2518.

D. Provide detailed drawings confirming configuration of Textile Dispersion System (diameter, lengths, airflow, pressure, and textile permeability).

E. Provide detailed installation instructions for components to be installed.

F. Provide warranty and maintenance documentation.

G. Provide product's Environmental Product Declaration (EPD) that includes the following:

1. Fabric.
2. Cutting, sewing, processing of DuctSox.
3. Zippers.
4. Metal suspension system parts and framework (if applicable).
5. Energy, water, recycled & waste of plant processing fabric & suspension.
6. Complete packaging including boxes, bags & staples.
7. Transportation.

1.5. WARRANTY

A. Manufacturer must provide a complete product (10) ten-year warranty for products supplied for the fabric and suspension of this system as well as a Design and Performance Warranty. Laundering frequency nor any other conditions shall pertain to warranty terms.

1.6. DELIVERY, STORAGE AND HANDLING

A. Protect textile air dispersion system and Hoops (IHS) components from damage during shipping, storage, and handling.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products manufactured in the United States by the following:

1. DuctSox - Sedona-Xm.

2. FabricAir, Inc. - Combi 80.

2.2 TEXTILE DISPERSION SYSTEM

A. Hoops (IHS) System: Air diffusers shall be constructed with internal retention system.

1. System shall consist of an internal 360 degree hoop system, spaced 5’ on center.

2. System shall be installed with a one row suspension system located 1.5” above top-dead-center of the textile system.

3. System attachment to U-Track shall be made using Gliders spaced 12 inches.

4. Available for diameters from 8” – 60”.

5. One row suspension options(must specify if multiple on same project)

a. U-Track suspension hardware to include 8’ sections of aluminum track, aluminum splice connectors, track endcaps and vertical cable support kits – consisting of a length of cable with cable connectors. Radius aluminum track must be included for all horizontal/flat radius sections.

1. U-Track suspension.

a. Impregnated steel cable(required for natatorium applications)

2. Support lengths available in 5’(standard), 10’, 15’, & 30’.

6. If within a natatorium, all metal structural components shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

B. TEXTILE

1. Sedona-Xm

a. Textile Construction: Filament / filament twill polyester treated with a machine washable anti-microbial agent by the fabric manufacturer, fire retardant in accordance with UL 2518.

b. Air Permeability: 2 (+2/-1) CFM/ft2 per ASTM D737, Frazier.

1. The air permeability of the fabric must NOT be created by perforating the fabric.
2. The air permeability must be confirmed be third party testing to eliminate the formation of condensate on the fabric.

a. Weight: 6.8 oz. /yd2 per ASTM D3776.
b. Warranty: 10 years.

2. Textile Color

a. Standard: blue, white, tan, red, green, silver, black.
b. Custom.

C. TEXTILE SYSTEMS FABRICATION REQUIREMENTS

1. Textile system to be constructed in modular lengths (zippered) with proper radial securing clips along the length of the system.

2. Integrated air dispersion shall be specified and approved by manufacturer. (select only those that apply).

    a. Linear Vents

        1. Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on .5" SP), starting a 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.

        2. Size of vent openings and location of linear vents to be specified and approved by manufacturer.

        3. Nozzles are not acceptable.

    b. Orifices

        1. Air dispersion and extended throws are accomplished by reinforced orifices and permeable fabric. Reinforced laser-cut orifices retain the integrity of the opening and withstand laundry processes.

        2. Diameter, quantity, and location of reinforced orifices to be specified and approved by manufacturer.

        3. Nozzles are not acceptable.

3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via. zip screw fastener – supplied by contractor.

4. Inlet connection includes zipper for easy removal / maintenance.

5. Lengths to include required intermediate zippers as specified by manufacturer.

6. System to include Adjustable Flow Devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.

7. End cap includes zipper for easy maintenance.

8. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.

D. DESIGN PARAMETERS:

1. Textile air diffusers shall be designed from 0.25" water gage minimum to 3.1" maximum, with 0.5" as the standard.
2. Textile air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F.

3. System overall design: diameter, length, airflow, operating static pressure and dispersion shall be designed or approved by the manufacturer.

4. Do not use textile diffusers in concealed locations.

5. Use textile air dispersion systems only for positive pressure air distribution components of the mechanical ventilation system.

2.3 TEXTILE DISPERSION SYSTEM

A. Air diffusers constructed with internal fabric tensioning system.

1. System shall cylindrically tension fabric along the entire length of fabric duct, including all fittings (crosses, elbows, reducers, and tees).

2. Tensioning system shall include full 360-degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.

3. Interior structure to include multiple mechanically adjustable tension devices. To provide proper fabric tensioning, structural and fabric system shall be configured in segments of no more than 42 feet.

4. Fabric components supported solely by metal cylindrical rings.

5. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.

B. Air diffusers constructed with external structural frame.

1. The system shall be made with sewn in but removable aluminum hoops. The hoops shall:

   a. Maintain the ducts' cylindrical shape at all times.

   b. Be made to a circular arc angle of 180° (8" - 48"), 120° (49" - 60"), 90° (61" - 68") or 60° (69" - 80") depending on duct diameter.

   c. Shall be centered at the 12:00 o'clock position of the duct.

   d. Shall be installed at the factory, on-site installation shall not be allowed.

2. Diameter and spacing of hoops shall be determined by the manufacturer based on duct diameter.

3. Elbows of 70° or more shall have at least two hoops.

4. Air dispersion shall be accomplished with linear or polar arrays of laser cut orifices. Size of laser cut orifices shall be from 1" to 5" diameter. Due to exact throw requirements and NC requirements alternative flow models are not acceptable.

5. Number of orifices shall be determined by manufacturer.
6. Fabric system shall include connectors to attach to suspension system.

7. If within a natatorium, all metal structural components shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

C. TEXTILE

1. Sedona-Xm

a. Textile Construction: Filament / filament twill polyester treated with a machine washable anti-microbial agent by the fabric manufacturer, fire retardant in accordance with UL 2518.

b. Air Permeability: 2 (+2/-1) CFM/ft2 per ASTM D737, Frazier.

1. The air permeability of the fabric must NOT be created by perforating the fabric.

2. The air permeability must be confirmed be third party testing to eliminate the formation of condensate on the fabric.

a. Weight: 6.8 oz. /yd2 per ASTM D3776.
b. Warranty: 10 years.

2. Textile Color

a. Standard: blue, white, tan, red, green, silver, black.
b. Custom.

D. TEXTILE SYSTEMS FABRICATION REQUIREMENTS

1. Provide system in modular lengths optimized for maintenance, connected by zippers with proper radial securing clips (inlets, endcaps and mid-sections) and top access zippers (if required) for vertical cable safety attachment. Zippers shall provide closure completely around the circumference to prevent leakage. Required number of zippers shall be specified by the manufacturer.

2. Integrated air dispersion outlets (orifices, nozzles, linear vents or other) shall be specified and approved by manufacturer.

3. The system shall be made of permeable fabric. Base permeability of fabric shall be reached based on a combination of weave construction and a thermo fixation process in order to prevent permeability degradation after wash. Fabric permeability based on a calendaring process is not acceptable.

4. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.

5. Inlet connection includes zipper for easy removal / maintenance.

6. Lengths to include required intermediate zippers as specified by manufacturer.

7. End cap includes zipper for easy maintenance.

8. Each section of the fabric shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information

E. DESIGN PARAMETERS

1. Fabric air diffusers shall be designed from 0.25” water gage minimum to 3” maximum, with 0.5” as the standard.

2. Fabric air diffusers shall be limited to design temperatures between -40°F and +284°F.

3. Design CFM, diameter, dispersion, static pressure, and diffuser length shall be designed or approved by the manufacturer.

4. Do not use fabric diffusers in concealed locations.

5. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.

PART 3 – INSTALLATION

3.1 INSTALLATION OF TEXTILE AIR DISPERSION SYSTEM

A. Install chosen suspension system with minor noise and fabric motion at start-up in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product. Suspension Track and cable within a natatorium shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

3.2 CLEANING AND PROTECTION

A. Clean air handling unit and ductwork prior to the fabric air dispersion system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.

B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

C. If fabric dispersion system becomes soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION 23 31 18

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Back-draft dampers.
2. Combination fire-and-smoke dampers.
3. Duct access doors.
4. Fire dampers.
5. Smoke dampers.
6. Volume control dampers.
7. Flexible duct connections
8. Duct Taps
9. Duct test holes
10. Flexible duct elbow supports

B. Related Sections:

1. Section 23 31 00 - HVAC Duct and Casings: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.

C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

A. Coordinate Work where appropriate with building control Work.

B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Arrow United Industries
2. American Warming and Ventilating
3. Ruskin
4. Air Balance
5. NCA
6. Pottorff
7. Greenheck

B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Cesco
2. NCA
3. Ruskin
4. Nailor
5. Pottorff
6. Greenheck

B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.

C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.

E. Temperature rating: 250°F.

F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.

G. Coordinate fire alarm control wiring with Division 26.

H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.

J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.

1. Less Than 12 inches square, secure with sash locks.

2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.

3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.

4. Larger Sizes: Furnish additional hinge.

5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Cesco
2. NCA
3. Ruskin
4. Nailor
5. Pottorff

6. Greenheck

B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.

C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.

D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.

E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.

G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Cesco
2. NCA
3. Ruskin
4. Nailor
5. Pottorff
6. Greenheck

B. Fabricate in accordance with UL 555S, Leakage Class I.

C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.

E. Temperature rating: 250°F.

F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

B. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.

3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

C. Single Blade Dampers: Fabricate for duct height up to 12”.

D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12” and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.

E. Damper Blades:

1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.

2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.

3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.

F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.

G. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.

2. On insulated ducts mount quadrant regulators on 2” standoff mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches furnish regulator at both ends.

4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.

H. Actuators:

1. Maximum damper area per actuator shall be 24 square feet face area.

2. Actuators shall be two position or modulating spring return type.

3. Duct mounted dampers shall have actuators mounted outside of air stream.

4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.

2. Net Fabric Width: Approximately six (6) inches wide.

3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.

4. Install flexible connections with a minimum of one (1) inch between metal edges.

5. Provide flexible duct connections at every duct connection to equipment.

C. Application:

1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8” steel axel and nylon end bearings with 2” standoff quadrant mount.

B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8” steel axel and nylon end bearings with 2” standoff quadrant mount.

C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.

D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.

B. Provide elbow supports at each diffuser connection.

C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify rated walls are ready for fire damper installation.

B. Verify ducts and equipment is ready for accessories.

C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 REPORTS

A. Per NFPA 90A, all fire dampers, smoke dampers and fire/smoke dampers must be tested prior to occupancy and contractor shall provide written confirmation if the dampers are operating as required. Provide pass / fail report in excel spreadsheet. Include type of damper, damper manufacturer / model, actuator manufacturer / model, fusible link in the excel spreadsheet.

B. Contractor to provide as-built drawings of location of all fire, smoke and fire/smoke dampers with appropriate label that matches the installation.

C. Per NFPA 80, contractor shall test and inspect all dampers prior to one (1) year warranty period. All inspections, testing and maintenance of dampers must be documented, indicating the location of the damper, date(s) of inspection, name of inspector and deficiencies discovered. The document must have a space to indicate when and how the deficiencies were corrected. All documentation is expected to be maintained and made available for review by the AHJ.

D. After first year, test and inspection frequency must be every 4 years.

3.3 INSTALLATION.

A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.

B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.

C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch

size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.

D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.

E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.

F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.

G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.
3. Install stainless steel volume dampers in stainless steel ducts.
4. Install aluminum volume dampers in natatoriums.

3.4 DEMONSTRATION

A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 33 19 - DUCT SILENCERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Duct silencers.
2. Crosstalk silencers.
3. Ductwork lagging.

1.3 PERFORMANCE REQUIREMENTS

A. Sound control components are selected to maintain the sound level of space at levels not to exceed those listed below. The midpoint of Noise Criteria (NC) curves shall apply.

B. Sound control components are designed to maintain rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by HVAC Applications and ANSI S1.8.

1. **Offices**

a. Executive: 30
b. Conference rooms: 30
c. Private: 35
d. Open-plan areas: 35
e. Computer/business machine areas: 40
f. Public circulation: 40

2. **Schools**

a. Lecture and classrooms: 30
b. Open-plan classrooms: 35

3. **Libraries:** 25

4. **Theaters**

a. Theater: 25
b. Stage house: 25
c. Trap room: 25
d. Orchestra pit: 25
e. Rehearsal rooms: 25
f. Teaching studios: 30
g. Practice rooms: 30
h. Ensemble rooms: 30
i. Shop: 45

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

C. Product Data: Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

D. Design Data: Submit selection of each individual trap. Selection shall indicate airflow and pressure drop. Sound attenuators shall be selected based on full return airflow.

E. Test Reports: Indicate acoustic housings meet or exceed specified sound transmission loss values.

F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

G. Manufacturer's Certificate: Certify silencers meet or exceed specified requirements.

H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of crosstalk silencers, acoustic housings, duct silencers and ductwork lagging. Record actual locations of hangers including attachment points.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36, standards and recommendations of ASHRAE 68.

B. Combustion ratings for the silencer acoustic fill material shall not be greater than the following when tested to ASTM E84, NFPA Standard 255 or UL No. 723:

1. Flame Spread Classification: 20
2. Smoke Development Rating: 20
3. Fuel Contribution: 20

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) year’s experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic

materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

B. Do not deliver Equipment to the project site until progress of construction has reached the stage where sound attenuators are actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 DUCT SILENCERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Aerosonics
2. United McGill
3. IAC
4. Vibro-Acoustics
5. Dynasonics
6. Commercial Acoustics
7. Ruskin
8. Price

B. Description: Sheet metal outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal with integral interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Configuration:

1. Tubular with inner casing and liner, aerodynamically shaped center body with nose cone and truncated tail cone, diameter and length as indicated on Drawings.

2. Rectangular with lined splitters with radius nose and contoured tails. Size as indicated on Plans.

D. Materials:

1. Outer Casing: Minimum 22 gage thick galvanized steel stiffened with mastic filled lock formed seams, two (2) inch long, 11 gage button punched slip joints on both ends.

2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.

3. Fill: Glass fiber or mineral wool of minimum 3 lb/cu ft density with antimicrobial and erosion coatings.

E. Rating:

1. ASTM E477 Insertion Loss and Maximum Generated Noise based on 1000 fpm Face Velocity. Performance criteria listed below based on IAC model LFM:

Insertion Loss (dB)

	Length -	Octave Band Center Frequency (Hz) 63	125	250	500	1000	2000	4000
Forward Flow	3 FT	4	7	13	16	15	10	9
	5 FT	6	10	17	25	25	14	11
Reverse Flow	3 FT	5	7	13	17	16	11	10
	5FT	7	12	19	27	27	14	13

Generated Noise (dB)

	Octave Band Center Frequency (Hz) 63	125	250	500	1000	2000	4000
Forward Flow (all lengths)	32	24	32	25	34	39	24
Reverse Flow (all lengths)	31	30	34	35	40	45	28

2. Maximum static pressure shall not exceed 0.17 inches wg.

3. Return air silencers installed at mechanical room walls shall be sized for full design return flow to mechanical room. Outside air and exhaust air shall not be subtracted from return in order to ensure silencers operate within design parameters for all modes of operation.

2.2 CROSS-TALK SILENCERS / TRANSFER DUCT

A. Description: Double wall sheet metal duct elbow with 1” insulation and perforated liner covering entire inside surface. Size as indicated on plans. Refer to Section 23 31 13 and detail on Plans.

B. Casing: Construct elbow using duct gauges specified for size shown.

C. Rating:

1. Size transfer duct at a maximum of 500 fpm Face Velocity.
2. Full design return air flow form space shall be used for sizing transfer ducts.
3. Maximum static pressure loss through transfer duct shall not exceed 0.05 inches wg.

2.3 DUCTWORK LAGGING

A. Acoustic Insulation: Two (2) inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.

B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft. All joints of covering shall be sealed as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support duct silencers independent of ductwork.

B. Install crosstalk silencers in wall. Pack and resiliently seal wall penetration.

C. Lag ductwork at wall by wrapping with insulation and covering. Lagging of duct will be identified on the plans. Apply covering to be airtight. Do not attach covering rigidly to ductwork. Fire damper sleeve shall be lagged at wall penetration, no exception.

D. Silencers shall be installed in accordance with manufacturer recommendations.

E. Silencers installed in duct systems that generate excessive system effect and pressure drop shall be removed and installed correctly by contractor at no additional cost.

F. Duct transition upstream of silencers shall be 30 degrees maximum. Duct transition downstream of silencer shall be 15 degrees maximum.

G. Silencers shall be installed a distance of (3x duct diameter) from elbows.

H. Silencers shall be installed a minimum of (1x duct diameter) from fan or unit outlets / inlets.

I. Where multiple silencers are ganged together provide continuous galvanized steel nosing, crimped or button punched, on internal partitions.

J. Silencers at mechanical room walls shall be installed with wall at midway point of casing. Pack and resiliently seal wall penetration. Silencers may be placed with overhang on either side of wall to allow coordination with trades.

K. Silencers located at fire rated walls shall be connected to wall sleeve of damper. Provide duct lagging on damper sleeve.

END OF SECTION 23 33 19

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide complete, fully operational fans where indicated on Drawings.

B. Section Includes:

1. Hooded propeller roof fans

2. Upblast centrifugal roof fans

C. Related Sections:

1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.

2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.

C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.

D. Manufacturer's Installation Instructions: Submit fan manufacturer’s instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.

D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.8 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each fan with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Capacity (CFM) and static pressure (w.g.).
- Motor Horsepower.
- Fan RPM.
- Unit Power Supply: Volts / PH / Amps.

- Supply Fan Drive Type.
- Sales Order #.
- Date of unit manufactured.

PART 2 – PRODUCTS

2.1 HOODED PROPELLER ROOF FANS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Greenheck
2. Cook
3. Twin City

B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.

C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.

D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14-gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18-gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000-hour salt spray under ASTM B117 test method.

F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7-gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.

H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

I. Drives: Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

J. Roof Curb:12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.

K. Accessories:

1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch. Damper shall be epoxy coated.

2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.

3. Direct drive units shall be provided with motor speed control option.

4. Birdscreen: Stainless steel rigid wire to protect fan discharge from birds or small objects.

2.2 UPBLAST CENTRIFUGAL ROOF FANS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Greenheck
2. Cook
3. Twin City

B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.

C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.

D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.

Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.

G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

H. Drives: Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.

J. Accessories:

1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch. Damper shall be epoxy coated.

2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.

3. Direct drive units shall be provided with motor speed control option.

4. Birdscreen: Stainless steel rigid wire to protect fan discharge from birds or small objects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed, and dimensions are as shown on shop drawings.

3.2 INSTALLATION

A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.

B. Install power ventilators level and plumb.

C. Install dampers in roof curb damper tray.

D. Provide hinged curb adapter to permit access to dampers and duct connection.

E. Install safety screen where inlet or outlet is exposed.

F. Provide sheaves required for final air balance.

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Air devices.

1.3 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.

2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

C. Test Reports: Rating of air outlet and inlet performance.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Titus
2. Price
3. Metalaire
4. Kruger

B. Mounting:

1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.

2. "T" Bar Ceilings: Lay-in type.

3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.

C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.

1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories “Fire Resistance Directory”.

2. Shall have a fire resistance rating of 3 hours.

3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.

4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.

5. UL listed thermal blanket insulation and mineral fiber around entire diffuser.

6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.

D. Source Quality Control

1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

E. Accessories:

1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify inlet and outlet locations.

B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Verify ceiling and wall systems are ready for installation.

E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers

B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.

C. Install diffusers, registers, and grilles level and plumb.

D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

A. Refer to Drawings.

END OF SECTION 23 37 13

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category IV Condensing Appliance double wall metal vents.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers and supports for placement by this section.

1.3 REFERENCES

A. Underwriters Laboratories Inc.:

1. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
2. UL 378 - Draft Equipment.
3. UL 441 - Gas Vents.
4. UL 641 - Type L Low-Temperature Venting Systems.
5. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.4 DESIGN REQUIREMENTS

A. Design refractory lined metal stacks for wind loading of 110 mph.

1.5 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Flue pipe shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.

C. Manufacturer shall provide a ¼” = 1’-0” scaled drawing within submittal showing flue pipe routing in plan and elevation views. Drawing of flue routing must be provided with dimensions showing code required distances away from intake hoods, intake louvers, etc. Include dimensions from finished roof to top of flue. Flue gasses discharged must not recirculate back into building by winds or inadequate spacing between any building envelope intakes.

EQUIPMENT SHALL BID AS AN ALTERNATE

D. Product Data: Submit data indicating factory-built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics, and connection requirements.

E. Product Data: Submit data on draft fans and accessories including fan curves with specified operating point plotted, power, RPM, and electrical characteristics and connection requirements.

F. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. All products furnished under this Section shall conform to the requirements of NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL and cUL listing mark or label.

B. Flue pipe shall be provided and submitted by boiler manufacturer submitting on project.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain water integrity of roof during and after installation of chimney or vent.

PART 2 – PRODUCTS

2.1 CATEGORY IV CONDENSING APPLIANCE DOUBLE WALL METAL VENTS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Metal-Fab
2. Heat-Fab
3. Simpson Dura-Vent
4. Ampco

B. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor’s Base Bid.

C. Fabrication: Inner pipe of sheet AL29-4C and outer pipe of 430 stainless steel, tested in compliance with UL 441.

D. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, NFPA-54; and NFPA-211, the Standard for Positive Pressure

EQUIPMENT SHALL BID AS AN ALTERNATE

Condensing Appliances. Products shall be listed to UL-441 and shall carry the appropriate UL or cUL listing mark or label.

E. The vent shall be of the double-wall, factory-built type for use with approved Category IV condensing appliances burning natural or LP gas, which produce flue gases exhausted at temperatures not exceeding 550º F.

F. The vent shall be constructed of an outer wall of 430 stainless steel, .018" thick for sizes 3" to 14" diameter, and .024" thick for sizes 16" to 30"diameter. The inner wall shall be constructed of AL29-4C, .035" thick for sizes 3" to 8" diameter and .048" thick for sizes 10" to 30" diameter. The vent shall include an integral, annular insulating air space, 1/4" thick for sizes 3" to 6" diameter and 1/2" thick for sizes 7" to 30" diameter.

G. Edges of inner and outer walls shall be sealed and joined according to manufacturer installation instructions.

H. All fittings, flashing, storm collar, cap, and appliance adapter required to install the vent shall be included.

I. Vent shall be tested and listed for a minimum clearance to combustibles of 1" for sizes 3" to 24" diameter and 2" for sizes 26" to 30" diameter.

J. Vent shall terminate as required by code.

K. Vent shall be installed in accordance with the vent manufacturer's installation instructions, UL listing and state or local codes.

L. Warranty: Furnish 1-year manufacturer warranty for manufactured units to begin at substantial completion.

M. Accessories, UL labeled:

1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.

2. Stack Cap: Consists of conical rain shield with inverted cone for partial rain protection with low flow resistance.

3. Exterior pipe and fittings shall be constructed entirely of type 304 stainless steel.

N. Application: Category IV Condensing Gas Appliances.

PART 3 - EXEXCUTION

3.1 PREPARATION

A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

3.2 INSTALLATION - GENERAL

A. Install in accordance with NFPA 54.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.

C. All double wall gas vents maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories for complete installation.

D. Install vent dampers, locating close to draft hood collar, and secured to breeching.

E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

F. Level and plumb chimney and stacks.

G. Clean breeching, chimneys, and stacks during installation, removing dust and debris.

H. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

I. Provide the appropriate and/or applicable chimney system continuous from appliances.

3.3 ENGINE EXHAUST AND BOILER STACK

A. Installation shall conform to the manufacturer's installation instructions, UL listing and state or local codes.

B. Support system from building structure using rigid structural shapes for attachment of fixed point supports (Plate Support Assembly). Anchor supports to structure by welding to inserts, bolting, steel expansion anchors or concrete inserts. Size of structural shapes shall be in accordance with manufacturer's recommendations.

C. Protect incomplete installations by attaching temporary closures over open ends of sections.

D. Clean all system sections of dust and debris prior to final connection to appliances.

E. Maximum unsupported horizontal spacing shall be nine (9) feet between guides.

F. Maximum unsupported vertical spacing shall be 19 feet between guides.

G. Pipe to be routed to minimize flow resistance.

H. Provide double wall bellows joint between each support and for every three (3) inches of expected expansion.

I. Provide support at roof penetration to support free standing of exhaust above roof and to keep stack centered in ventilated thimble assembly.

J. Provide drain bucket at bottom of vertical stack, piped to nearest floor drain.

K. Provide ventilated thimble and storm collar at roof penetration.

EQUIPMENT SHALL BID AS AN ALTERNATE

L. Provide flip top fitting at stack termination or engine exhaust.

M. Provide stack cap on boiler stack termination.

END OF SECTION

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 52 16 - CONDENSING BOILER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Heating water boiler heat exchanger.
2. Boiler control panel.
3. Hot water boiler trim.
4. Natural gas fired burner.

B. Boiler shall be completely factory assembled and tested on a structural steel base and be ready for water, gas, and electric connections.

C. Boiler and all components shall be CSA certified.

1. ASME Section IV (Heating Boilers)
2. ANSI Z21.13 / CSA 4.9 (Gas Fired Low Pressure Boilers)
3. NFPA 54 (ANSI Z221.3)National Fuel Gas Code
4. ASME CSD-1 (Controls and Safety Devices)

D. Related Sections:

1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolators for placement by this section.
2. Section 23 11 23 - Gas Piping: Execution requirements for gas piping connections to boilers specified in this section.
3. Section 23 51 00 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.
4. Division 26 - Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

1.3 REFERENCES

A. ASME Section IV (Heating Boilers)

EQUIPMENT SHALL BID AS AN ALTERNATE

B. ANSI Z21.13/CSA 4.9 (Gas Fired Low Pressure Boilers)

C. NFPA 54 (ANSI Z221.3) National Fuel Gas Code

D. ASME CSD-1 (Controls and Safety Devices).

1.4 SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Flue pipe as specified per 23 51 00 Breechings, Chimneys, and Stacks, shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.

C. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.

D. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test.

E. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Conform to ASME Section IV for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

B. Gas Train and Safety Controls: Industrial Risk Insurers.

C. Unit Certification: CSA certified.

D. Boilers shall comply with 2012 International Energy Conservation Code.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.8 DELIVERY, STORAGE, AND HANDLING

A. Boilers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 WARRANTY

A. The boiler manufacturer shall provide an entire boiler parts and labor warranty (including circulating pump) for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.

B. Provide an extended parts and labor warranty for the following:

1. Burner and Heat Exchanger: Five (5) years from date of substantial completion.

2. Thermal shock: Ten (10) years from date of substantial completion.

C. In addition to entire parts and labor warranty, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, and any expenses related to service calls required to diagnose and correct warranty issues.

D. The manufacturer shall provide factory certificates for each boiler listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.10 GENERAL

A. Each factory "packaged" boiler shall be complete with all components, accessories, and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.

B. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged" boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

PART 2 – PRODUCTS

2.1 CONDENSING WATER BOILERS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 97 % on 500 MBH input boilers and less and not less than 97% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68º F.

C. Boiler shall comply with ASME Section IV for 80 psig, max 200º F (100 psig on 1500 MBH and larger units).

D. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 in.wc. to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 in.wc.

2.2 BOILER DESIGN

A. Each hot water boiler shall consist of a stainless-steel primary only heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified. Boilers requiring a secondary heat exchanger (economizer) to achieve condensing operation will not be permitted as well as copper-finned heat exchangers.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Each boiler heat exchanger shall be stainless-steel, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section.

C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.

E. Boiler heat exchanger headers, tube sheets, fire-tubes, and combustion chamber shall be fully welded stainless steel and have a removable burner opening for inspection.

F. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16-gauge carbon steel. The front and top wall shall be secured in place with ¼ - 20 NC bolts (sheet metal screws are not acceptable). The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and materials to assure an outer casing temperature of not more than 50°F above ambient temperature when the boiler is operated at full rated load.

G. An observation port shall be located on the boiler to allow for observation of the burner flame.

H. Flue gas outlet shall be located on the rear of the boiler. Boiler to be certified for installation with Category IV venting (stack) as defined in NFPA 54 (ANSI Z221), latest edition. The boiler sales representative must provide venting (stack) certified for installation on a Category IV appliance in accordance with 23 52 16 – 1.4.B.

2.3 BOILER TRIM

A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:

1. Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.

2. Water pressure-temperature gauge.

3. Primary low water flow fuel cutoff (probe type with manual reset).

4. Manual reset high limit water temperature controller.

5. Operating temperature control to control the sequential operation of the burner.

2.4 BOILER FUEL BURNING SYSTEM

A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Each burner shall be provided with an integral gas firing combustion head.

C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.

D. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall be a maximum of 900 watts and operate at 6,000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the LED display.

E. Each burner shall of the radial-fired (down-fired) type and constructed of steel with a stainless-steel inner and stainless-steel mesh outer screen.

F. Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

G. The Microprocessor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:

1. Maintain single set point

2. Reset the set point based on outdoor air temperature.

3. Boiler shutdown based on outdoor air temperature.

4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)

5. Alarm relay for any for any manual reset alarm function.

6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.

7. LED Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.

8. Local Manual Operation.

9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate.

10. Computer (PC) interface for programming and monitoring all functions

EQUIPMENT SHALL BID AS AN ALTERNATE

2.5 MAIN GAS VALVE TRAIN

A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:

1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.

2. Air – Gas ratio control (maximum inlet pressure 14 in.wc.)

3. One (1) low gas pressure switch (manual reset).

4. One (1) high gas pressure switch (manual reset).

5. Two (2) pressure test ports.

2.6 IGNITION SYSTEM

A. Each boiler shall be equipped for direct ignition or proven pilot ignition.

2.7 COMBUSTION AIR CONTROL

A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:

1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.

2. One (1) low airflow differential pressure switch to ensure that combustion air is supplied.

3. High exhaust back pressure switch.

2.8 BURNER CONTROL SYSTEM

A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The power supply to each boiler shall be protected by a circuit breaker located in the MCC (supplied by contractor).

B. The boiler shall include direct ignition or proven pilot ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.

C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

EQUIPMENT SHALL BID AS AN ALTERNATE

2.9 BURNER CONTROL PANEL

A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components: all prewired to a numbered terminal strip:

1. One (1) burner "on-off" switch.

2. One (1) electronic combination temperature control, flame safeguard and system control.

3. Control circuit breaker, 5 amp

4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.

5. LED Display Panel to adjust set points and control operating parameters. LED display to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, and sensor values such as inlet, outlet, flue gas and outdoor air.

2.10 BUILDING AUTOMATION SYSTEM INTERFACE:

A. Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. A BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed locally at boiler control panel shall be available through building automation system.

2.11 FACTORY TESTING – HYDROSTATIC

A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME “H” stamp.

2.12 FACTORY TESTING – FIRE TESTING

A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install boilers plumb and level, to plus or minus 1/16 inch over boiler base. Stacking of boilers is unacceptable.

B. Maintain manufacturers recommended and code minimum clearances around and over boilers.

EQUIPMENT SHALL BID AS AN ALTERNATE

C. Install boiler on concrete housekeeping pad, minimum four (4) inches high and six (6) inches larger than boiler base on each side. Refer to Section 23 05 29 - Hangers and Supports For HVAC Piping and Equipment.

D. Install boiler on vibration isolators in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

E. Connect natural gas piping in accordance with NFPA 54.

F. Connect natural gas piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances and unions for burner removal and service.

G. Connect hot water piping to supply and return boiler connections.

H. Install the following piping accessories. Refer to Section 23 05 19 - Meters and Gages For HVAC Piping.

1. On supply:

a. Thermometer well for temperature controller.

b. Thermometer well and thermometer.

c. Well for control system temperature sensor.

d. Strainer.

e. Nipple and flow switch.

f. Pressure gage.

g. Shutoff valve.

2. On return:

a. Thermometer well and thermometer.

b. Well for control system temperature sensor.

c. Pressure gage.

d. Shutoff valve.

e. Balancing valve.

I. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23 - Gas Piping.

1. Strainer.

2. Pressure gage.

3. Shutoff valve.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Check valve.

5. Pressure reducing valve.

6. Unions.

J. Install discharge piping from relief valves and drain valves to nearest floor drain.

K. Install boiler trim and accessories furnished loose for field mounting.

L. Install electrical devices furnished loose for field mounting.

M. Install control wiring between boiler control panel and field mounted control devices.

N. Connect flue to boiler outlet, full size of outlet.

O. Route each gas trim vent, separately, to the outdoors. Vent lines sizes shall be a minimum the equivalent size pipe connection. Provide union at each device to facilitate change-out and in the vertical to allow the burner door to swing open. Terminate vents a sufficient distance from air intakes, turn down and provide insect screen.

P. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

3.2 FIELD QUALITY CONTROL

A. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent NOx, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

B. Arrange with local authorities having jurisdiction for inspection of boiler, piping, and for certificate of operation. Provide written certification from boiler manufacturer that installation is in compliance with manufacturer's written instructions.

C. Prior to boiler startup, Contractor to inform Owner to have boiler inspector inspect installation for proper installation and submit for State Operating Certificate.

3.3 BOILER INSPECTION REQUIREMENTS

A. All new boilers, regardless of new construction or renovation of existing systems, are required to receive inspection by a state boiler inspector or their assigned agent prior to any boiler being energized, no exceptions. A boiler requiring inspection is generally defined by the following characteristics.

1. Heat input exceeds 200,000 Btuh.
2. Nominal water-containing capacity exceeds 120 gallons.

B. As per Boiler Safety Administration Rules, 65.20, The Owner or operator are the only persons that can submit a request for inspection of a boiler by the state or their agent. The inspection agent has at least 30 days to schedule an inspection date with the Owner.

EQUIPMENT SHALL BID AS AN ALTERNATE

During an emergency situation where a boiler is replaced due to mechanical failure of an existing boiler, the agent may grant approval to the Owner to allow startup before inspection but that is at the agent's discretion.

C. The installing contractor is required to submit the following documents to the Owner before the Owner can submit for state inspection.

1. Contractor shall complete the attached Boiler Inspection Installation Report and notify the district HVAC department personnel in charge of maintaining all inspection certification documentation for the district.

2. Contractor shall submit all manufacturer's cut sheets and product information on boiler being inspected.

3. Hydrostatic test results on boiler being inspected.

4. Contractor shall submit this information to the Owner in a timely manner so the inspection can be scheduled and performed prior to project completion.

D. As per the Health and Safety Code, Chapter 755, September 1, 2003.

1. Nuclear, high pressure or steam boilers must receive an annual certificate of inspection and an annual external inspection if they meet these characteristics.

   a. Pressures exceeding 160 psi.

   b. Temperatures exceeding 250 degrees Fahrenheit

2. Steam heating boilers and hot water heating boilers shall be inspected biennially (every two years) if they meet these characteristics:

   a. Pressures not exceeding 160 psi.

   b. Heat input exceeds 200,000 Btuh.

   c. Water temperature greater than 210 F but not greater than 250 degrees Fahrenheit

   d. Nominal water-containing capacity exceeds 120 gallons.

3. Hot water supply boilers shall be inspected triennially (every three years) if they meet these characteristics:

   a. Pressures not exceeding 160 psi.
   b. Heat input exceeds 200,000 Btuh.
   c. Water temperature not exceeding 210 degrees Fahrenheit; or Nominal water-containing capacity exceeds 120 gallons.

E. Inspection Responsibilities

1. Preparing the boiler for inspection is listed in the Boiler Safety Administrative Rules, Section 65.70.

   a. Water shall be drawn off and the boiler thoroughly washed.

EQUIPMENT SHALL BID AS AN ALTERNATE

b. All manhole and hand hole plates, washout plugs, and plugs in the water column connections shall be removed as necessary for complete inspection. The furnace and combustion chambers shall be thoroughly cooled and cleaned.

c. All grates and internally fired boilers shall be removed.

d. Brickwork shall be removed as required by the inspector in order to determine the condition of the boiler, headers, furnace, supports or other parts.

e. The pressure gage shall be removed for cleaning of the siphon and testing, if necessary.

f. The low water cutoff device shall be dismantled, cleaned, and prepared for inspection.

g. Before removing the manhole or hand hole covers and entering any part of the boiler connected to a common header with other boilers any leakage of steam or hot water shall be eliminated. The non return and stop valves must be closed, tagged, and preferably padlocked, and drain valves between the two valves opened. The feed water valves must be closed, tagged, and preferably padlocked. After draining the boiler, the blowdown valves shall be closed and preferably padlocked. Blowdown lines, where practicable, shall be disconnected between pressure parts and valves. All vent and drain lines shall be opened.

h. If the boiler is jacketed so that the seams of shells, drums or domes cannot be seen, enough of the jacketing, setting wall, or other form of casing or housing shall be removed to permit inspection to determine the safety of the boiler, provided such information cannot be determined by other means.

2. For initial boiler inspection after installation:

a. Once an inspection date has been established between the inspector and Owner, the boiler manufacturer’s representative shall be available on-site for boiler inspection.

b. The manufacturer’s representative shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.

c. The manufacturer’s representative will be responsible to re-assemble boiler back to its original state and then schedule a startup test with the installing contractor and Owner. All product warranties shall begin once startup has been completed and unit is available for use as designed.

3. For annual boiler inspection:

a. Once an inspection date has been established between the inspector and Owner, the Owner or their assigned contractor shall be available on-site for boiler inspection.

EQUIPMENT SHALL BID AS AN ALTERNATE

b. The Owner or their assigned contractor shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.

c. The Owner or their assigned contractor will be responsible to re-assemble boiler back to its original state and place the boiler in good working condition.

3.4 MANUFACTURER'S FIELD SERVICES

A. Start-up boilers according to manufacturer's start-up instructions and in presence of boiler manufacturer's representative and Owner's representative. Test controls and demonstrate compliance with requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

3.5 CLEANING

A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

3.6 DEMONSTRATION

A. Demonstrate operation and maintenance procedures.

B. Furnish services for manufacturer's technical representative for one (1) 8-hour day to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least seven (7) days notice to Architect/Engineer of training date.

END OF SECTION 23 52 16

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 64 27 - ROTARY-SCREW WATER CHILLERS AIR-COOLED

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a complete operational Rotary-Screw Water Chiller.

B. Related Sections:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2. Section 23 90 00 "Refrigerant Detection Monitoring System" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

3. Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment - Product requirements for Vibration Isolators for placement by this section.

4. Section 23 05 19 Meters and Gages for HVAC Piping: Product requirements for piping specialties for placement by this section.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

E. kW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.4 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

2. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. Underwriters Laboratories Inc.:

1. UL 1995 - Heating and Cooling Equipment.

1.5 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.

C. Shop Drawings: Indicate components, assembly, dimensions, weights, and loads, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

D. Product Data: Submit rated capacities, specialties and accessories, electrical requirements, and wiring diagrams.

E. Design Data: Indicate energy input versus cooling load output from 25 to 100 percent of full load at specified and minimum condenser water temperature.

F. Test Reports: Indicate results of factory performance test.

G. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements including components not produced by manufacturer.

I. Manufacturer’s Field Reports: Submit start-up report for each unit. Indicate results of leak test and refrigerant pressure test.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.

2. Piping roughing-in requirements.

3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.

4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Source quality-control reports.

D. Startup service reports.

E. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

1.8 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 550 certification program.

B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.

C. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.

2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1[, as applicable to chiller design]. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.

F. Comply with NFPA 70.

G. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

EQUIPMENT SHALL BID AS AN ALTERNATE

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. If chiller is mounted on structural-steel support structure coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

1.10 WARRANTY

A. The chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period **Ten (10) years**. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.

B. Extended warranty shall include FULL machine parts, labor, and refrigerant warranty for complete chiller components. All chiller components to be included such as but not limited to refrigerant, compressors, motors, starters, variable frequency drives, evaporator tube bundles, water boxes, fans, controls, electrical parts, and gear assemblies (as applicable) etc. In the event of failure, the chiller manufacturer shall provide a new motor, compressor, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.

C. In addition to full machine parts, labor and refrigerant, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.

D. The manufacturer shall provide factory certificates for each chiller listing as a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.11 PREVENTATIVE MAINTENANCE SERVICE

A. Furnish service and maintenance of chillers for period of five (5) years from Date of Substantial Completion. Preventative Maintenance start dates from shipment or startup will not be accepted.

B. Include, on a quarterly basis, systematic examination, required adjustments, lubrication of unit and controls calibration. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use new parts produced by manufacturer of original equipment.

C. Perform work without removing units from service during building normal occupied hours. Off-line chiller work must be coordinated with Owner.

D. At no additional cost to owner provide emergency call back service at all hours during this maintenance period.

EQUIPMENT SHALL BID AS AN ALTERNATE

E. Maintain locally adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

F. All maintenance work shall be performed by factory direct service technician. Maintenance work shall not be performed by installing mechanical contractor.

G. Do not assign or transfer maintenance service to agent or subcontractor.

H. Provide 3 quarterly unit inspections per year.

I. Provide 1 annual unit inspection per year to include:

1. Provide oil analysis at year 1 and at year 4.
2. Condenser coil brushing each year (five total).
3. Provide evaporator tube eddy current testing at year 3.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Chillers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

F. Protect units from physical damage. Leave factory covers in place until startup of machine.

EQUIPMENT SHALL BID AS AN ALTERNATE

PART 2 – PRODUCTS

2.1 ROTARY-SCREW WATER CHILLERS AIR-COOLED

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. Product Description: Factory assembled and tested, packaged air-cooled liquid chiller consisting of semi-hermetic rotary screw or hermetic scroll compressors, suction gas-cooled compressor motor, condenser coils, evaporator, refrigeration accessories and control cabinet with single point power connection.

2.2 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- Capacity (tonnage).
- Entering and leaving water temperature.
- Flow rate (GPM).
- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
- Refrigerant type.
- Sales Order #.
- Date of unit manufactured.

2.3 SPECIAL PROJECT REQUIREMENTS

A. Manufacturer shall provide to the owner diagnostic software and associated licensing for 5 users. Software and licensing shall be valid for no less than 5 years from substantial completion.

2.4 COMPRESSORS

A. Rotary Screw Compressor:

1. Semi-hermetic rotary screw compressor with capacity control slide valve, rolling element bearings and differential refrigerant pressure oil pump and oil heater.

2. Direct drive, constant speed, suction gas-cooled, semi- hermetic motor.

3. Crankcase heater shall energize when compressor is not running.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Refrigerant used shall be **R-513A**.

5. Each compressor shall have an isolated refrigerant circuit piped such that burnout of one compressor shall not damage the other compressor(s). Compressors shall not be piped in parallel arrangement into one refrigerant circuit.

B. Lube oil system shall include filtration devices with proper valves for removal of filter without removal of refrigerant charge.

C. Ultra Low Sound Compressor Control: Chiller manufacturer shall provide the following attenuation package and meet scheduled maximum A-weighted sound pressure level rating of 70dBA at 30' from the condenser coil side of chiller per AHRI. Complete sound attenuation package shall be provided regardless of if scheduled dBA is met without.

1. Acceptable sound attenuation package manufacturer: BRD-Noise and Vibration Control Inc. (Factory attenuation packages only are not acceptable)

2. Complete Ultra-low sound package shall be manufactured by BRD – Noise and Vibration Control, Inc., Hushcore™ Product line, no exceptions.

Contact: Kristopher Gonzalez – (610) 881-4490

3. Provide ultra-low sound blanket on a minimum of 100% coverage of each compressor, suction line, discharge line and oil separator: no exceptions.

4. Removable Sound Covers shall be constructed with a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.^{3} density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with "D" rings and Velcro™ fasteners. The inner and outer jackets shall protect against UV rays, oil, and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified chiller. Stainless steel wire tie fastening assemblies are not acceptable.

5. Provide detailed ultra low sound acoustical data with submittal, no exceptions. Data shall include sound pressure rating across each octave band and A-weighted average for chiller as built with attenuation package.

2.5 EVAPORATOR VESSEL

A. Shell and tube type, seamless or welded steel construction with cast iron or fabricated steel, heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Furnish multiple refrigerant circuits on multiple compressor units. Include a minimum of two (2) circuits.

B. Furnish with factory installed freeze protection heaters down to -20oF ambient temperature.

C. Design, test, and stamp refrigerant side for 220 psig working pressure and water side for 300 psig working pressure, in accordance with ASME Section VIII.

EQUIPMENT SHALL BID AS AN ALTERNATE

D. Furnish water boxes, with tapped drain and vent connections with flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant.

E. Furnish refrigerant chambers with baffles to distribute entering liquid and separate liquid from leaving gas.

F. Insulate with 0.75-inch minimum thick, closed cell foam, vapor barrier insulation with a maximum K factor of 0.26. This insulation shall have a 3mm thick PE embossed film to provide additional damage resistance as well as be UV resistant. **Provide electric resistance immersion heater with thermostat to protect evaporator from freezing down to -20º F. ambient. This heater shall be field powered separate from main unit power by the 120V control circuit connection.**

G. Furnish water drain connection and thermometer wells for temperature controller and low temperature cutout.

H. Provide fusible plug in accordance with ASHRAE-15.

2.6 CONDENSER COILS, FANS AND MOTORS

A. Coils shall be microchannel and shall have a series of flat tubes containing a series of multiple parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion resistant coating. Tubes shall be cleaned, dehydrated, and sealed. 3. Assembled condenser coils shall be pressure tested at the coil factory at 660 psig and subsequently shall be leak tested at 145 psig ±5 psig and pressure tested at 350 psig at final unit assembly.

B. Coils shall have a factory applied post-construction, flexible, epoxy polymer e-coat uniformly applied to all coil surface areas without material bridging between fins. Humidity and water immersion resistance shall be up to a minimum 1,000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92). Corrosion durability shall be confirmed through testing to no less than 6,000 hours salt spray per ASTM B117-90. Coated coils shall receive a spray-applied, UV-resistant polyurethane topcoat to prevent UV degradation of the e-coat. Coating shall carry a 5-year warranty, from the date of substantial completion.

C. Louvered/Wire Panels: Factory installed louvered panels on external condenser coil faces, painted to match unit panels. Factory louvered panels around the base and ends of the machine to restrict unauthorized access.

D. Low Sound Fans: Reduced rpm, vertically direct driven propeller type condenser fans with fan guard on discharge. Fans shall have a minimum of 7 polymer blades with baffling. Metal blade fans are not acceptable.

E. Fan Motors: High efficiency 8-pole low RPM motor, direct drive fan connection, 3 phase power, insulation class “F”, current protected, Totally Enclosed Air-Over (TEAO) with double sealed, permanently lubricated ball bearings.

EQUIPMENT SHALL BID AS AN ALTERNATE

2.7 SOUND RATINGS

A. Noise Rating: Emitted A-Weighted Sound Pressure Level shall not exceed scheduled dBA at 30 feet from sides of the unit when measured according to ARI STANDARD 575.

B. Acoustic sound compressor blankets and Low Sound Fans shall be provided regardless of if scheduled dBA is met without.

2.8 REFRIGERANT CIRCUIT

A. Dual refrigerant circuits with one compressor per circuit.

B. Furnish for each refrigerant circuit:

1. Liquid line solenoid valve.
2. Filter dryer (replaceable core type without refrigerant loss or removal).
3. Liquid line sight glass and moisture indicator.
4. Electronic expansion valve.
5. Charging valve.
6. Insulated suction line.
7. Discharge line check valve.
8. Compressor discharge service valve.
9. Pressure relief device.
10. Oil separator.

2.9 CONTROLS

A. Factory mounted watertight steel control cabinet containing contactors, power and control wiring with factory wired single point power connection and non-fused disconnect switch with handle extending through face of cabinet. Control cabinet shall include microprocessor-based control system. System shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. Control panel shall include LCD display with keypad interface. Display messages shall be plain English. A coded two- or three-character display is unacceptable.

B. Control panel shall be NEC409 and UL508A compliant with 65k SCCR (High short circuit current rating).

C. Chiller manufacturer shall provide a BACnet interface card (gateway) in control panel. Mounting, wiring, programming, and calibration of gateway shall be provided by chiller manufacturer. Chiller supplier shall provide BAS contractor with point list and programming information as needed.

1. A BACnet communication network interface card with building automation system shall enable building automation system operator to remotely control and monitor the chiller from an operator workstation. Control features available, and monitoring points displayed, locally at chiller control panel shall be available through building automation system.

D. Gateway shall include the following communication ports: One Ethernet port, one serial port configurable for EIA-232 or EIA-485 and one EIA-485 serial port.

E. Gateways that transfer data in proprietary language are not acceptable.

EQUIPMENT SHALL BID AS AN ALTERNATE

F. Gateway shall support open protocol communication for data sharing, alarm and event management, scheduling, trending and device and network management.

G. Furnish the following safety control with indicating lights arranged so machine is shut down and requires manual reset.

1. High condenser refrigerant pressure.

2. Low oil pressure.

3. High oil temperature.

4. High motor current.

5. High motor temperature.

6. Low refrigerant (evaporator) pressure.

7. High bearing temperature.

H. Furnish the following safety controls. Operating any one control shuts down machine:

1. Low chilled water temperature.

2. Chilled Water Integral flow switches within chiller. Flow proving switches shall be thermal dispersion type (IFM U 40100 or approved equal). Switches shall be listed in U.L., SPDT snap-acting, and pilot duty rated (125 VA minimum). Flow switch shall have relay output, wire break output and temperature output. Flow switch shall be redundant; control contractor to provide flow switch within piping.

3. Loss of an electrical phase.

I. Furnish manual machine off-auto switch on control panel and the following manual or menu driven software display.

1. Machine selector switch to allow hand, off, or automatic operation.

2. Manual Set Point Adjustments:

a. Leaving chilled water temperature.

b. Current demand limit.

3. Status display:

a. Chilled water flow proven.

b. Cooling required.

1. Unit running.

2. Unit loading.

EQUIPMENT SHALL BID AS AN ALTERNATE

3. Unit unloading.

4. Manual reset required.

5. Remote chilled water set point active.

6. Remote current water set point active.

4. Set point and Temperature Display:

a. Chilled water set point.

b. Current limit set point.

c. Entering evaporator water temperature.

d. Leaving evaporator water temperature.

e. Entering condenser water temperature.

f. Leaving condenser water temperature.

5. Dial or Electronic Type Pressure Indicators.

a. Evaporator refrigerant pressure.

b. Condenser refrigerant pressure.

c. Low oil pressure (oil sump).

d. High oil pressure (oil supply).

J. Furnish the following operating controls:

1. Multi-step chilled water temperature controller to cycle compressor and activate capacity controls, with remote thermostat.

2. Five minute off timer prevents compressor from short cycling.

3. Periodic pump-out-timer to pump down on chilled water flow and high evaporator refrigerant pressure.

4. Provide low ambient control and high ambient options as required to ensure unit is capable of operation from 0°F to 115°F ambient.

5. Thermostat to cycle fan motors in response to outdoor ambient temperature.

6. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

7. VFD control to vary speed of one at least one condenser fan motor in response to refrigerant condensing pressure.

EQUIPMENT SHALL BID AS AN ALTERNATE

8. Load limit thermostat to limit compressor loading on high return water temperature.

9. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.

10. Provide capacity control system capable of reducing unit capacity to 10% of full load. Compressor shall start in unloaded condition. Application of factory installed hot gas bypass on screw compressors shall be acceptable as required to meet specified minimum load. For scroll compressors, hot gas bypass must be provided and sized for minimum compressor loading on one circuit only. No exceptions.

11. Cycle counter and operating hour meter.

2.10 FACTORY MOUNTED VARIABLE FREQUENCY DRIVE

A. VFDs for each compressor shall have a DC link reactor.

B. All VFDs on the chiller (compressor motors and fans) shall be fully air-cooled and shall not require an additional glycol cooling system. If supplying a VFD glycol cooling system, the following must be provided in conjunction with and for the duration of the service/maintenance agreement specified in section 23 64 27 – 1.12.

1. Glycol solution replacement every 5 years

2. Annual pH test

3. Annual fluid level check

4. Annual glycol condenser cleaning

2.11 CHILLER PERFORMANCE

A. Minimum efficiency shall be COP of 2.80 and IPLV of 2.80 per 2001 IECC Supplement Table.

2.12 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Coordinate voltage with electrical drawings, ensure Overcurrent protective device size and type, and minimum circuit capacity are provided per unit manufacturer's published data.

B. Factory mounted non-fused molded case disconnect switch.

C. Single point power connection and grounding lug.

D. Provide integral 120V control power transformer.

E. Provide all 120V accessory branch circuits indicated on unit manufacturer's wiring diagram, including separate connection for oil heaters.

EQUIPMENT SHALL BID AS AN ALTERNATE

F. Power Factor:

1. Provide equipment with factory installed power factor correction capacitors as required to maintain a power factor of 95% at all load conditions.

2.13 FIELD CONDUCTED EDDY CURRENT TEST - REQUIRED

A. The installing mechanical contractor shall provide the necessary special test equipment and services of a trained technician to conduct an eddy current test of the evaporator tubes prior to chiller startup. In addition, the mechanical contractor shall coordinate the presence of the awarded chiller factory trained technician to witness the test and ensure the factory warranty remains intact. Submit final report to Owner and Engineer.

B. Each Chiller associated with project shall be tested.

C. Four (4) copies of the eddy current test and their results shall be submitted to the Owner and Engineer for record keeping.

2.14 FACTORY CAPACITY TEST

A. The chiller manufacturer shall provide the necessary special test equipment and services of a factory trained technician to conduct various capacity tests prior to delivery to the project. Tests shall verify and certify that project equipment is in compliance with the Contract Documents.

B. Tests shall be conducted in accordance with AHRI Standard 550/590. The five (5) percent capacity allowance specified in the AHRI test standard shall not be applied.

C. Four (4) copies of the tests and their results shall be submitted to the Engineer for approval within five (5) calendar days from chiller test date. If test results do not demonstrate compliance with the Contract Documents, the project chillers will be tested with required correction procedures until compliance can be certified.

D. Conform to UL 1995 code for construction of chillers and furnish UL label.

E. Conform to ASME Section VIII for construction and testing of chillers.

2.15 PUMPOUT SYSTEM-IF REQUIRED

A. Provide service valves and connections for refrigerant pump-out to remote storage tank using portable condensing unit. Valves are not required if chiller is capable of pumping the entire refrigerant charge into condenser vessel for storage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install chiller on concrete housekeeping pad minimum four (4) inches high and six (6) inches wider than chiller base on each side. Refer to Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.

B. Install units on vibration isolation. Refer to Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.

EQUIPMENT SHALL BID AS AN ALTERNATE

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Install chiller accessories furnished loose for field mounting.

E. Install electrical devices furnished loose for field mounting.

F. Install control wiring between chiller control panel and field mounted control devices.

G. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit. Refer to Division 26, Electrical.

H. Provide the following piping accessories on evaporator chilled water piping connections.

3.2 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping" and Section 23 23 00 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to chiller to allow service and maintenance. Piping shall be arranged for easy dismantling to permit tube cleaning. Locate shut-off valves to permit removal of piping for access.

D. Evaporator Fluid Connections: Connect to evaporator inlet with nipple and flow switch, shutoff valve, Y-strainer, flexible connector, thermometer well for temperature controller, thermometer well and thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with flow switch with DDC interface, shutoff valve, balancing valve, flexible connector, thermometer well and thermometer, thermometer well for temperature controller, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling manufactured by Victaulic. Refer to Sections 23 05 19 Meters and Gages for HVAC Piping and 23 21 13 Hydronic Piping.

E. Provide control wiring between chiller control panel and field mounted control devices.

F. Provide connection to electrical service.

3.3 STARTUP SERVICE

A. A factory direct authorized service representative shall perform startup service. Chiller startup shall not be performed by contractor.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that refrigerant charge is sufficient, and chiller has been leak tested.

3. Verify that pumps are installed and functional.

EQUIPMENT SHALL BID AS AN ALTERNATE

4. Verify that thermometers and gages are installed.

5. Operate chiller for run-in period.

6. Check bearing lubrication and oil levels.

7. Verify that refrigerant pressure relief device is vented outside.

8. Verify proper motor rotation.

9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.

10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.

11. Verify and record performance of chiller protection devices.

12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

3.4 FIELD QUALITY CONTROL

A. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.

3.5 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's representative shall certify in writing that installation is in compliance with manufacturer's recommendations.

B. Furnish services of factory trained representative for minimum three (3) days to leak test, refrigerant pressure test, and start-up, calibrate controls, and instruct Owner on operation and maintenance.

C. Oil Test: An oil sample shall be taken at start-up from each compressor. Sample will be used as a reference for all warranty oil tests. Oil samples shall be taken annually. The samples shall be tested using the Karl Fisher test method. If test indicates moister in oil, Contractor shall obtain factory recommended procedure to fix problem. Procedure shall be submitted to Engineer prior to any work being done. All labor and materials for corrective work shall be covered by manufacturer. Oil test shall be analyzed, and report submitted to engineer within 30 days of sample date. Oil samples shall be tasted by Analysts Services, Inc., or manufacturer provided testing services.

EQUIPMENT SHALL BID AS AN ALTERNATE

3.5 DEMONSTRATION AND TRAINING

A. Demonstrate system operations and verify specified performance. A functional test of the installed chiller control system shall be performed to demonstrate proper functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.

B. Coordinate testing with Testing and Balancing Contractor.

3.6 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean chiller externally and internally to remove foreign material and construction dirt and dust. Clean condensing coils, condensing fans, frame, etc.

B. **Prior to building occupation, contractor shall clean condenser coils free from dirt and debris.**

END OF SECTION

EQUIPMENT SHAL BID AS AN ALTERNATE

SECTION 23 73 13.19 – CUSTOM INDOOR CENTRAL-STATION AIR HANDLING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular factory fabricated air-handling units and accessories.

B. Related Sections:

1. Section 23 05 00 - Common Work Results for HVAC.

2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.

4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.

5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.

6. Section 23 05 14 - Variable Frequency Controllers.

1.3 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.

C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.

D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

1. Dimensioned plan and elevation view drawings, including motor starter and control cabinets, required clearances, and location of all field connections.

2. Cabinet material, metal thickness, finishes, insulation and accessories.

3. Ladder-type schematic drawing of the power and auxiliary utility field hookup requirements, indicating all items that are furnished by the manufacturer.

EQUIPMENT SHAL BID AS AN ALTERNATE

4. Manufacturer’s performance of each unit. Selection shall indicate, as a minimum, the following:

    a. Fan curves with system operating conditions indicated.
    b. Certified coil performance ratings with system operating conditions.
    c. Calculations required for base rail heights to satisfy condensate trapping requirements of cooling coil.
    d. Filters with performance characteristics.
    e. Rated load amp draw.
    f. Approximate unit shipping weight.

E. Product Data, Submit the following:

1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.

5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

F. Manufacturer's Installation Instructions: Submit.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.

2. Piping roughing-in requirements.

3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.

4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Source quality-control reports.

D. Startup service reports.

EQUIPMENT SHAL BID AS AN ALTERNATE

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.

B. Operation and Maintenance Data: Submit manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Units shall comply with the requirements of UL-60335-2-40 and NFPA 90.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic

EQUIPMENT SHAL BID AS AN ALTERNATE

materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.9 REQUIRED FIELD UNIT LEAKAGE AND DEFLECTION TEST

A. After the unit has been set and leveled, and prior to installation of ductwork, controls, or electrical components, manufacturer shall perform a field air leakage and cabinet deflection test. Cabinet leakage rate shall not exceed 1% of total design airflow and L/240 deflection at +10" W.C.Field test shall be conducted by the manufacturer, or local representative, and witnessed by the Engineer and owner's representative. Up to four panels shall be measured for deflection at the mid-point of the panel joints. Manufacturer or local manufacturer's representative shall provide a full report showing full compliance and signed by the manufacturer or manufacturer's local representative. Provide the owner, engineer, and contractor a copy of passing report. Additional work to the unit cannot be conducted until unit successfully passes leakage test.

1.10 WARRANTY

A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable.

B. Fan assemblies and fan motors shall be warrantied through 4 years from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "By Others". Extra materials shall be clearly labeled by unit name in protective container and delivered to the Maintenance and Operations department for attic stock.

1. Filters: Four (4) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, new set at substantial completion and a set for attic stock. Filters shall be protected with polyester fabric at all times

EQUIPMENT SHAL BID AS AN ALTERNATE

during construction. A list of all filter sizes and locations shall be turned over to the Owner at Substantial completion as part of the close-out documents.

1.12 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

PART 2 – PRODUCTS

2.1 CUSTOM INDOOR CENTRAL-STATION AIR-HANDLING UNITS

A. Manufacturers: Subject to compliance with scheduled efficiencies, capacities, and specification, provide products by the following manufacturers.

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. All air handling units shall be of the same manufacturer and same model; mismatched manufacturer's will not be acceptable.

C. Configuration: Coordinate with project plans and schedules.

D. Performance Base: Sea level pressure or altitude.

E. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

F. Refer to Equipment Schedule for maximum allowable dimensions. Submitted Custom Air Handling Units shall not exceed scheduled length, width, height, and weight.

G. If equipment other than the equipment listed as "Basis of Design" is provided, it is the mechanical contractor's responsibility to confirm that submitted equipment meets scheduled performance, equipment footprint does not exceed scheduled maximum allowable dimensions or scheduled maximum allowable weight and that all applicable piping and duct connections such as but not limited to supply, return, exhaust, and outside air do not deviate from plans.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

A. In order to demonstrate energy compliance with current local 2021 IECC performance method, the project as specified and scheduled was energy modeled and complies. Alternate manufacturers are allowed but must not exceed maximum scheduled brake horsepower, efficiency, etc. The equipment's cooling, heating, humidifying, ventilating, exhausting capacity and performance shall meet or exceed that shown on the schedule.

EQUIPMENT SHAL BID AS AN ALTERNATE

B. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable. Units exceeding any scheduled dimension will not be accepted.

C. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control's contractor. This applies to all the air handling units with energy recovery wheel and any unit with outside and return air ducted to the plenum.

D. The custom air handling unit manufacturer shall provide a minimum of 5 days of field labor assistance during assembly. Coordinate time with owner and engineer to field verify and witness; provide a minimum of (5) five business day's notice.

2.3 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Project name and address.
- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- CFM.
- Entering and leaving air temperature (DB/WB) (cooling and heating coil).
- Entering and leaving water temperature (cooling and heating coil).
- Cooling and heating coil flow rate (GPM).
- Fan Motor Horsepower.
- Blower est. ext. sp. (in. wg.).
- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
- Sales Order #.
- Date of unit manufactured.

B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.4 CASING

A. Full perimeter welded double-bottom steel base assembly constructed with a minimum of A500 structural steel tubing, phenolic coated for minimum 1,000-hour salt spray resistance per ASTM B117-95 and shall be a minimum of six (6) inches in height. Welded 12-gauge C-channel cross supports shall be located on maximum 24" centers. All panels shall utilize thermal break construction between the exterior panel and the interior liner and between the panels and the base and roof frames and shall be insulated with a minimum of 4" thick, R-27 closed-cell sprayed foam to ensure air/water-tight construction. Assemble multiple sections with gaskets and bolts and caulk all seams after assembly.

B. Outside Casing:

1. Galvanized Steel: 16-gauge G90 with expanded foam injected insulation.

EQUIPMENT SHAL BID AS AN ALTERNATE

2. Panels shall be individually removable for service without removing the roof or compromising the integrity of the cabinet wall. Panel attachment with screws is not acceptable. All panels shall utilize thermal break construction between the exterior panel and the interior liner and between the panels and the base and roof frames.

C. Inside Casing:

1. Marine Grade Aluminum: Solid 16-gauge 55052. Provide 18 gauge perforated panels in the fan section and discharge plenum. To allow for cleaning, no fasteners shall be used on the exposed liner surface. Single wall units are not acceptable.

D. Floor and Subfloor:

1. Aluminum Treadplate type 3003 embossed with four way tread plate finished to high gloss. The thickness shall me a minimum of 0.125” base with 0.185” over treads.

E. Casing shall be supported by structural panels. Framing members shall have thermal break and injected with expanded foam insulation. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory with a minimum 1/4-inch-thick x 3/4 inch wide closed-cell neoprene. Top and side panels shall be easily removable for service.

F. Insulation: Minimum R-20 Expanded Foam-in-Place Construction.

1. ‘K’ (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.148 Btuh inch / sq. ft. / degrees Fahrenheit.

2. Density: Three (3) inch thick, minimum 3 lbs. /cu ft. density throughout the entire unit.

3. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.

4. Insulation in perforated sections shall be coated on air side to prevent erosion into air stream. Uncoated insulation is unacceptable.

5. Panels constructing which utilize foam board are not acceptable.

G. Access Section: 24” access section with minimum 36” door width and minimum 84” height (refer to details). Access door and window frames shall be foam insulated, include a thermal break, and constructed of aluminum. Access doors shall match the construction and materials of the unit casing and include dual automotive neoprene gaskets, latch and handle assembly, and stainless-steel adjustable mounting hardware. Doors shall be a minimum of 3” thick with R-20 injected foam insulation. Provides access doors with windows between parallel coil sections, mixing sections, filter sections, and fan sections. Doors shall open against static pressure or shall include a pressure relief safety feature on the door latch. All doors shall have a minimum of two latches. A minimum of 10”x12” thermal pane viewing window with one wire mesh safety glass pane and one clear pane

EQUIPMENT SHAL BID AS AN ALTERNATE

shall be provided. The frame shall have a no-through-metal thermal break design. Doors shall be provided with one (1) test port with screw cap.

H. Drain Pans: Drain pans shall be included for both chilled and hot water coils. Drain Pans shall be 16-gauge 304 stainless steel pans with minimum three (3) inch expanded foam insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Cooling coils with a finned height greater than 48 inches shall have an intermediate 16-gauge 304 stainless steel drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning. Drain pans shall have a factory applied post-construction, flexible, epoxy polymer e-coat. Drain pan connection is to be 304 stainless steel.

I. Strength: Cabinets shall be constructed in a watertight and airtight manner. The manufacturer's standard cabinet construction shall result in an ASHRAE/ANSI Standard 111 Leakage Class 5 rating, or better, as measured in accordance with AMCA Standard 210. Furnish structure to brace casings for suction pressure of ten (10) inch wg, with maximum deflection of L/240. Deflection and leakage test shall be performed at the factory prior to shipment. Results shall be provided to engineer to compare to field testing. Deflection test shall be measured on the standing seam at the midpoint of the longest panel span on the side of the unit. Maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

J. Panel Screws: All panel screws shall be stainless steel.

2.5 BLOWER

A. Type: Refer to Air Handling Unit Schedule for fan type and drive type.

1. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from welded aluminum. Entire fan assembly shall be polymer epoxy E-coated for superior corrosion resistance.

B. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.

C. The Fan wheels shall be keyed to shaft to prevent slipping.

D. Construction: AMCA Class III minimum.

E. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.

F. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.

G. Bearings: Grease-lubricated ball bearings designed to deliver a minimum L10 life of 250,000 hours at full load and the maximum operating RPM of the associated fan. Grease zerks and spring-loaded grease relief valves shall be provided in each motor to allow easy bearing lubrication without damaging the seals due to over lubrication. Permanently lubricated bearings are allowed if a spare motor per array is provided.

EQUIPMENT SHAL BID AS AN ALTERNATE

H. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. For fan/motor assemblies balanced to meet AMCA Standard 204-96 that do not meet or exceed category BV-5, mount fan array base on vibration isolators with deflections in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment or 2" deflection, whichever requirement is stricter Vibration & seismic controls shall be coated for corrosion resistance.

I. Each fan and motor assembly shall be independently isolated within the structural assembly using 1-inch deflection spring isolators. Isolators shall be mounted in a three-point arrangement that provides both vertical and horizontal (thrust) isolation and shall not require field adjustment. If hard mounted or rubber in shear is used in place of internal spring isolations, external isolation of the entire unit is required by the unit manufacturer. If external isolation is used, the contractor must flex all connections to the unit. Unit must be internally spring isolated to eliminate the need for contractor installed vibration isolation for noise mitigation.

J. Fan Modulation: Variable frequency drive.

K. Flexible Connection: Provide internal flexible connection between fan and air unit casing. Flexible connection between air unit casing and connecting duct shall not be provided when fan is internally isolated with flexible connection to casing.

L. Fan Array Systems shall be designed for full cabinet face area airflow distribution. At a minimum, provide the number of fans scheduled to achieve a 90% cross sectional area distribution.

M. Each fan/motor assembly, intake wall and inlet cone shall be constructed of minimum 14-gauge G90 galvanized steel and coated to exceed a 1,000-hour salt spray resistance per ASTM B117-95.

N. All fan / motor assemblies shall be provided with zero net effect vertical aluminum backdraft dampers in aluminum frame. These non-controlled dampers shall provide for isolation in event a fan fails or is turned off and to prevent filters from being pulled into the fan section.

O. Fan Motors: All motors shall be premium efficiency, NEMA MG-1Section 3, Inverter Duty, Totally Enclosed Fan-Cooled (TEFC). Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers. ECM motors are not acceptable.

P. In the supply fan section, provide an overhead motor removal system to facilitate motor replacement. Preferred method is a manually operated winch, capable of being easily moved to any motor location or provide motor removal rail with winch and gantry.

Q. Fan array shall be provided such that if one fan fails, the remaining fans can provide the design airflow. Controls Contractor to provide sequencing to automatically adjust VFD to correct frequency upon detection of fan failure (determined by individual fan piezo rings)

EQUIPMENT SHAL BID AS AN ALTERNATE

2.6 BEARINGS AND DRIVES

A. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-10 life at 250,000 hours.

B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated to prevent corrosion.

C. Motor Shaft Grounding Kit: For all AHU motors, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.

D. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg. All fan motors shall be in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

1. Motor Enclosure: Totally Enclosed Fan-Cooled (TEFC); ECM motors shall not be acceptable.

2. Provide (2) two forged motor lifting eyes and oversized conduit boxes with ground lugs.

3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

4. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified

2.7 COILS

A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with coated blank-offs and casing sealing grommets at connection penetrations. Coils shall be supported by minimum 16 gauge 304 stainless steel coil support members maintaining a minimum of 1” separation between bottom of coil casing and drain pan.

B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

C. Water Heating Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.

2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

3. 24-inch access section between parallel coil faces.

4. Casing: Die formed channel frame of minimum 16-gauge 304 stainless steel.

EQUIPMENT SHAL BID AS AN ALTERNATE

5. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.020" copper. ½" OD tubes will not be acceptable.

6. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.008" aluminum.

7. Coil supports shall be 16-gauge type 304 stainless steel.

D. Water Cooling Coils:

1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.

2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

3. Coils shall be a maximum of eight (8) rows deep.

4. 24-inch access section between parallel coil faces.

5. Casing: Die formed channel frame of 16-gauge 304 stainless steel.

6. Drain Pans: Extend 24 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.

7. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.020" copper. ½" OD tubes will not be acceptable.

8. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.008" aluminum.

9. Coil supports shall be 16-gauge type 304 stainless steel.

E. Tube Velocities: Coil tube design velocity shall be between 2 feet and 5 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained.

2.8 DAMPERS

A. All dampers shall be factory installed and constructed of heresite coated aluminum.

B. Provide Class 1A rated, ultra-low leak dampers (less than 3 cfm/sq ft. @ 1" w.g.). Low leakage dampers shall have extruded aluminum airfoil blades mounted in a 6063T5 extruded aluminum frame. Flat or formed metal blades are not acceptable. The damper blade shall incorporate ruskiprene edge seals and zinc plated or stainless-steel tubular steel shaft for a non-slip operation. Shaft bearings shall be spherical molded synthetic to eliminate friction and any metal-to-metal contact. Damper jamb seals shall be UV rated, nylon glass reinforced designed for a minimum air leakage and smooth operation. Damper operators shall be provided, installed, and wired by the BAS subcontractor.

EQUIPMENT SHAL BID AS AN ALTERNATE

2.9 AIR FILTRATION

A. Filter Box: Section with filter guides, access doors as shown on plans, for face loading with gaskets and blank-off plates. Filter frame assembly shall be constructed of 16-gauge 304 stainless steel.

B. Filter Rack: Frames shall be installed with vertical stiffeners and appropriate frame to frame sealant to provide a rigid leak tight assembly.

C. Filter Frames: Pad holding frames shall be permanent metal frames designed to contain replaceable filter media pads. Frames shall be constructed of 22-gauge, galvanized steel U channel cell sides, expanded metal support grid, 9 gauge hinged retainer gate, sized to fit in standard universal holding frames, and accept maximum 2” thick media. Acceptable manufacturers: AAF or pre-approved equal.

D. Replaceable Filter Media: MERV 13 or greater rating in accordance with ASHREA Test Standard 52.2-2007.

E. High-Capacity Angle Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.

F. Filter Area: Max velocity of 350 FPM.

G. Filter Gauges: Provide Dwyer 2000 (photohelic) magnehelic gauges, 4” diameter and shall be accurate to ±2% of full range. One gauge shall be provided for each filter bank. Gauges shall be recessed into cabinet casing.

H. Provide list of each air handling unit with associated filter sizes to owner at substantial completion.

I. Provide permanently attached ladder with slide rail system to access all filters.

2.10 CONTROLS

A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

2.11 CAPACITY

A. Performance: Provide equipment as scheduled on Drawings.

2.12 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Provide equipment with electrical characteristics as shown on Electrical Drawings.

B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.

C. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.

D. Motor Overload Panel: For units with more than one fan, and to allow for a connection to a single variable frequency drive, provide a factory mounted and wired motor overload panel. Panel shall be UL listed, NEMA 3R enclosure with IECC manual starters with rotary type operators and auxiliary contacts.

EQUIPMENT SHAL BID AS AN ALTERNATE

E. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

F. Marine Lights: Each section with an access door shall include an LED marine light. Wire all lights to a single light switch located adjacent to the fan section access door.

G. 120v / 1ph /60hz GFCI Convenience Outlets: Refer to detail of where factory installed and wired convenience outlets are required.

H. All internal electrical and controls conduit shall be constructed of EMT galvanized conduit.

2.13 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with ARI 430.

B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases; Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.

G. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.

EQUIPMENT SHAL BID AS AN ALTERNATE

H. Installation of Hot Water Heating and/or Chilled Water Coil:

1. Make connections to coils with unions. Position unions to permit coil removal.

2. Connect water supply to leaving airside of coil (counter flow arrangement).

3. Locate water supply at bottom of supply header and return water connection at top.

4. Install water coils to allow draining and install drain connection at low points.

5. Install the following piping accessories on piping connections. Refer to Section 23 21 13 - Hydronic Piping.

a. On supply: (refer to details)

1. Thermometer well and thermometer.
2. Well for control system temperature sensor.
3. Shutoff valve.
4. Pressure gage.
5. Strainer

b. On return: (refer to details)

1. Air vent.
2. Thermometer well and thermometer.
3. Well for control system temperature sensor.
4. Pressure gage.
5. Modulating control valve.
6. Flow control balancing valve.
7. Shutoff valve.

6. Install valves and piping specialties in accordance with details as indicated on Drawings.

7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.

I. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short-circuited during operation.

3.2 CONNECTIONS

A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Where installing piping adjacent to units, allow space for service and maintenance.

C. Hydronic Piping Connections:

EQUIPMENT SHAL BID AS AN ALTERNATE

1. Comply with requirements in Section 23 21 13 "Hydronic Piping."

2. Install shutoff valve and union or flange on each supply connection and install balancing valve and union or flange on each return connection.

D. Duct Connections:

1. Comply with requirements in Section 23 31 13 "Metal Ducts."

2. Drawings indicate the general arrangement of ducts.

3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."

E. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Deflection and leakage test shall be performed at the factory prior to shipment. Results shall be provided to engineer to compare to field testing. Deflection test shall be measured on the standing seam at the midpoint of the longest panel span on the side of the unit. Maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

2. After installation, perform air leakage test with factory personal. Maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

3. After installation, fill water coils with water, and test coils and connections for leaks.
4. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

EQUIPMENT SHAL BID AS AN ALTERNATE

2. Verify that shipping, blocking, and bracing are removed.

3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.

4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.

6. Verify that zone dampers fully open and close for each zone.

7. Verify that face-and-bypass dampers provide full face flow.

8. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.

9. Comb coil fins for parallel orientation.

10. Verify that proper thermal-overload protection is installed for electric coils.

11. Install new, clean filters.

12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean

EQUIPMENT SHAL BID AS AN ALTERNATE

fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

3.8 PROTECTION OF FINISHED WORK

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. All air units shall remain in manufacturer’s protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

END OF SECTION

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 74 13 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units with the following components and accessories such as but not limited to:

1. Direct-expansion cooling.
2. Hot-gas re-heat.
3. Natural Gas Furnace Heating.
4. Integral, space temperature controls.
5. Roof curbs.

B. Electrical characteristics: Coordinate with electrical plans prior to submitting equipment; provide single point power connections.

1.3 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Provide line-by-line specification review annotated to certify compliance or deviation.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.

3. Prepare the following:

a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

EQUIPMENT SHALL BID AS AN ALTERNATE

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

C. Startup service reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.

2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.

2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. **Warranty shall begin from date of Certificate of Substantial Completion**. Provide a sample of manufacturer's warranty certificates as described below within equipment submittal. **Warranty start dates from shipment or startup will not be accepted**.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. **Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty** for rooftop units. All components to be included such as but not limited to refrigerant, compressors, evaporator coils, condenser coils, electric heaters, gas-fired heaters, roof curbs, motors, starters, variable frequency drives, controls, etc. In the event of failure, the manufacturer shall provide a new motor, compressor, fan, evaporator coil, condenser coil, and controllers, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.

C. In addition to full machine parts, labor and refrigerant, the Standard warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.

D. The manufacturer shall provide factory certificates for each Rooftop Unit listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or “By Others”. Extra materials shall be clearly labeled by unit name in protective container and delivered to the Maintenance and Operations department for attic stock.

1. Filters: Four (4) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, new set at substantial completion and a set for attic stock. Filters shall be protected with polyester fabric at all times during construction. A list of all filter sizes and locations shall be turned over to the Owner at Substantial completion as part of the close-out documents.

1.9 FACTORY TESTING

A. All units shall be factory assembled, internally wired, fully charged with refrigerant, and 100% tested prior to leaving the factory. Certified factory testing report shall be sent to owner and engineer upon request. The factory test shall include a refrigerant circuit test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection. If unit fails any portion of the certified test, failures shall be corrected before unit leaves the factory.

B. If for any reason unit does not meet the manufacturer’s standards, those items shall be corrected and re-tested prior to leaving the factory with no additional cost to the owner.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and

trap condensate and cause corrosion. Original factory packaging shall not be deemed as acceptable protection of equipment.

B. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

D. Protect units from physical damage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Equipment shall be bid as an alternate. Refer to 01 23 00 ALTERNATES for acceptable manufacturers as well as RFP-CSP #1006; XXXI. Exhibit S – Bid Alternates and Unit Price Form.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

B. Configuration: Coordinate with project plans and schedules.

C. Performance Base: Sea level pressure or altitude.

D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts and performs final unit inspection.

2.2 CASING – APPLIES TO ROOFTOP UNIT: RTU-04

A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Construction:

1. Thermal break double wall.

C. Exterior Casing Material: 22-gauge galvanized steel with factory painted finish capable of withstanding at least 700 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure. Roof panels shall be

pitched with overhangs above access doors, and knockouts with grommet seals for electrical and piping connections and lifting lugs.

D. Casing Fabrication Requirements:

1. Inside casing: 24 Gauge galvanized steel.

E. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

F. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

G. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.

H. Unit base pan shall be provided with minimum 1-inch-thick foam insulation.

I. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM D1929-11 with a minimum flash ignition temperature of 610°F.

2. Double wall thickness and density: 2 inches, 3 lbs. density engineered polymer foam injected.

J. Condensate Drain Pans: Formed sections of welded Type 304 stainless-steel sheet, a minimum insulation of two (2) inches deep and complying with ASHRAE 62.1.

1. Double-Wall Construction: Fill space between walls with expanded foam insulation with a thermal break and seal moisture tight.

2. Cross break and pitch to drain connection.

3. Drain Connections: Threaded nipple.

4. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of the coil intermediate drain pan shall have a minimum of two drop tubes to main pan.

5. Drain pans shall allow no standing water and must be accessible for cleaning.

K. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

L. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

EQUIPMENT SHALL BID AS AN ALTERNATE

M. Base Rails: Full perimeter galvanized rails for mounting on roof curb or pad as indicated.

N. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

O. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

P. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

2.3 CASING – APPLIES TO ROOFTOP UNITS: RTU-01, RTU-02, RTU-03

A. General Fabrication Requirements for Casings: Formed and insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Construction:

1. Single Wall

C. Unit cabinet shall be constructed of galvanized steel and shall be bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces. Unit cabinet exterior paint shall be film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F): 60, Hardness: H-2H Pencil hardness.

D. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb. density, aluminum foil faced fiberglass insulation, Aluminum foil-faced fiberglass insulation shall also be used in the heat compartment

E. Condensate Drain Pans:

1. Shall be an internally sloped condensate drain pan made of a non-corrosive material.

2. Shall comply with ASHRAE Standard 62.

3. Shall use a 3/4” -14 NPT drain connection, possible either through the bottom or end of the drain pan. Connection shall be made per manufacturer’s recommendations.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

G. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

H. Base Rails: Base rail shall be a minimum of 16-gauge thickness.

I. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

EQUIPMENT SHALL BID AS AN ALTERNATE

J. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed. Provide hinged access doors in all sections, including mixing boxes, filter sections, downstream of all coils, and upstream and downstream of all fan systems.

2.4 FANS

A. Direct-Driven Supply-Air Fans: Single width, single inlet, direct drive plenum; with permanently lubricated, VFD driven motor resiliently mounted in the fan inlet. Painted-steel or aluminum wheels with solid steel motor shaft.

B. Direct-Driven Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

1. Low sound operating, PVC coated fan guard, to discharge vertically. FRP construction on condenser fans under 15-tons. Fully dipped and baked epoxy on condenser fan assembly is also acceptable.

2. Condenser Fan Motor: Totally enclosed air over (TEAO), permanently lubricated ball bearings; resiliently mounted; overload protected. Motors shall be ECM, Electronically Commutated Motors, or VFD driven on all units.

3. Provide factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.

4. Fan Safety Guards: Steel with corrosion-resistant coating.

C. Supply Fan Motor:

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2. Enclosure: Open-Drip Proof (ODP). **ECM motors are not acceptable.**

3. Supply fans shall be provided with a (VFD) variable frequency drive for balancing and soft start purposes. VFD shall be factory provided and installed and wired in a ventilated controls compartment by manufacturer prior to shipment. Externally mounted VFD’s shall be provided in NEMA 3R enclosure.

4. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on fan isolation sled with rubber in shear isolators. Fan wheel and motor shall be dynamically balanced after assembly. Furnish access to motor, drive, and bearings through hinged access doors.

2.5 COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.

B. Leak Test: Coils shall be leak tested with air underwater.

EQUIPMENT SHALL BID AS AN ALTERNATE

C. Supply-Air Refrigerant Coil:

1. Aluminum plate fin and seamless copper tube with brazed joints in galvanized steel casing with equalizing-type vertical distributor.

2. Tube Header Material: Seamless Copper.

3. Fin and Tube Joints: Mechanical bond.

4. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.

5. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.

D. Outdoor-Air Refrigerant Coil:

1. Aluminum Microchannel in galvanized steel casing with equalizing-type vertical distributor.

2. All condenser coils require louvered panels for added protection of the condenser coils from hail and other physical damage.

E. Hot-Gas Reheat Refrigerant Coil (Required):

1. Aluminum Microchannel in galvanized steel casing with equalizing-type vertical distributor.

2. Aluminum microchannel construction in aluminum casing with equalizing-type vertical distributor.

3. Refrigerant Coil Capacity Reduction: Circuit coils for intertwined control.

4. Shall be available and provided as a factory installed option. Hot-gas reheat coil shall be modulating control. On/off control not acceptable.

5. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a dehumidification control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

6. Evaporator temperature to be precisely controlled by monitoring the compressor saturated suction temperature.

7. Shall be capable of simultaneously operating both the non-hot-gas reheat compressor circuits and hot-gas reheat compressor circuits of multiple compressor units when both the humidity level and the first stage cooling temperature level exceed their set points.

8. Shall be capable of prioritizing a cooling demand over a dehumidification demand and shut off the hot-gas reheat coil circuit(s) to meet the temperature requirements. Shall be

able of turning the hot-gas reheat coil back on if the dehumidification demand still exists after the cooling demand has been met.

9. Shall consist of a reheat coil, three-way solenoid valve, a check valve and associated copper piping.

10. Reheat coil shall be constructed with enhanced aluminum fins mechanically bonded to copper tubes. Fin count shall not exceed 14 fins per inch.

11. Reheat coil shall be located on the leaving air side of the evaporator coil.

12. Three-way solenoid valves shall be non-modulating type and normally closed for the reheat coil.

13. Check valve shall be provided to prevent reverse flow of refrigerant during cooling operation.

2.6 REFRIGERANT CIRCUIT COMPONENTS

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll compressors mounted on integral vibration isolators, internal overcurrent and high temperature protection, internal pressure relief and crankcase heater.

D. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.

E. Refrigerant: R-454b.

1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

F. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant filter/dryer.
3. Manual-reset high-pressure safety switch.
4. Automatic-reset low-pressure safety switch.
5. Minimum off-time relay.
6. Automatic-reset compressor motor thermal overload.
7. Brass service valves installed in compressor suction and liquid lines.
8. Low-ambient kit high-pressure sensor.
9. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
10. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.

G. Capacity Control: **APPLIES TO ROOFTOP UNT**: **RTU-04**

EQUIPMENT SHALL BID AS AN ALTERNATE

1. For units 3 to 10 nominal tons: Single circuit, single inverter VFD compressor.

2. For units > 10 and ≤ 20 nominal tons: Provide single refrigerant circuits with a minimum of two compressors; an inverter VFD compressor shall be used as the lead compressors and an additional compressor shall be single stage hermetic scroll-type paired in tandem with lead inverter compressor.

3. For unit's ≥ 20 nominal tons: Provide dual independent refrigerant circuits with up to four compressors. An inverter VFD compressor shall be used as the lead compressor on the lead refrigerant circuit and an additional compressor shall be single stage hermetic scroll-type paired in tandem with lead inverter compressor. Staged compressors shall be used for the lag circuit.

4. Evaporator temperature is to be measured and controlled by a cold coil leaving air temperature sensor.

H. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.7 GAS FURNACE HEATING

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners:

1. Heat-Exchanger Material: Stainless steel with a minimum thermal efficiency of 80 percent.

2. Fuel: Natural gas.

3. Ignition: Electronically controlled electric spark with flame sensor.

C. Heat-Exchanger Drain Pan Material: Stainless steel.

D. Venting: Gravity vented.

E. Safety Controls:

1. Gas Control Valve: Electronic modulating.

2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 AIR FILTRATION

A. Filters: Maximum 2" thick, disposable pleated media type, 16 pleats per linear foot, MERV 13 or greater rating in accordance with ASHRAE Test Standard 52.2-2007.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Replaceable Filter Media: As indicated above or greater rating in accordance with ASHRAE Test Standard 52.2.

C. High-Capacity Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches w.g; dirty pressure drop of 0.75 inches w.g.

D. Filter Area: Max velocity of 350 FPM.

E. Acceptable manufacturer: Airguard, American Air Filter, or prior approved equal.

2.9 DAMPERS

A. Outside Air and Economizer Damper Assembly: Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of Galvanized Steel. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 1 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood and adjustable barometric relief dampers.

B. Damper assembly shall be controlled by spring return, modulating actuator.

C. Once set, outdoor air dampers shall open to the minimum set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.

D. Demand Control Ventilation: Provide a factory installed and wired return air CO2 sensor to override the damper actuator to provide more outside air.

E. Bird Screen: Provide 1-inch aluminum mesh prefilter upstream of the outside air opening.

F. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.10 ELECTRICAL POWER CONNECTION

A. Provide single connection of power to unit with unit factory mounted disconnect switch accessible from outside unit.

B. General Electrical Power Connection Requirements: Factory-installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

C. Convenience Outlet: A GFCI, 120v/15amp, 2 plug, unpowered convenience outlet connection shall be a separate electrical feed and not from the main.

D. Enclosure: NEMA 250, Type 4X, mounted in unit with hinged access door in unit cabinet having tool lockable doors.

E. Wiring: Numbered and color-coded to match wiring diagram.

F. Wiring Location: Install factory wiring outside an enclosure in a raceway.

EQUIPMENT SHALL BID AS AN ALTERNATE

G. Power Interface: Field power interface shall be to [wire lugs] [NEMA KS 1, heavy-duty, non-fused disconnect switch].

H. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

2. NEMA KS 1, heavy-duty, non-fusible switch.

3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

I. Factory-Mounted, Overcurrent-Protection Service: For each motor.

J. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity. Convenience outlet shall be a separate electrical connection and not powered from the main electrical feed.

K. Controls: Factory wire unit-mounted controls components to a terminal strip for connection to third party BAS controller.

L. Control Relays: Auxiliary and adjustable time-delay relays.

M. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

2.11 CONTROLS

A. Refer to Sequences of Operation within Controls specification.

B. BAS Interface: Completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions including space temperature, leaving air temperature, space humidity, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times and diagnostics. The system shall be provided with all required temperature sensors, pressure sensors, controller, and keypad/display operator interface. All microprocessor boards, hardware and software shall be factory provided and installed to enable the BAS to monitor, control, and display unit status and alarms.

C. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Units shall provide an external location for mounting a fused disconnect device. 24-volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring. Unit shall have single point power entry as standard.

1. Unit controller shall be capable of controlling all features and options of the unit.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.

3. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.

4. Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.

2.12 ROOF CURBS (PROVIDED BY RTU DISTRIBUTER AND NOT "BY OTHERS"):

A. Fully welded custom curb shall be constructed of 14 gauge, G90 galvanized steel and designed to mate with the down flow (confirm arrangement with plans) supply and return openings and provide support and a watertight seal. The custom curb design shall allow field-fabricated rectangular supply and return ductwork with turning vanes in the supply section and to be connected directly to the curb. Walls shall have 2" insulation with 2" insulation on floor. Curb design shall comply with NRCA requirements. Curbs shall be shipped fully welded and insulated and include wood nailer strips.

B. Provide curb having vertical members insulated with a minimum thermal resistance (R-value) of 6.0 BTU/hr-ft2-°F or greater.

C. Provide curb with continuous insulation between unit base and curb. All walls and floors are to be insulated with 2" fiberglass insulation.

D. Curb height shall be a minimum of 48".

E. Roof Curb for Horizontal Airflow (where scheduled or shown on plan details) - Horizontal openings in curb shall be custom designed for return and/or discharge for horizontal air handling. Opening size and location shall be indicated on drawings and/or schedule.

F. **Curbs shall be rated for a minimum of 155 mph and certified by structural engineer upon submittal. Certification shall be provided within submittal for approval.**

G. Provide sound attenuation manufactured by BRD HUSHCORE DS-49 Noise Control System and shall be in full compliance with the following specifications:

1. The overall installed thickness shall be 14" for DS-49 products.

2. Shall meet Class "A" per ASTM E84 for flammability.

3. The composite panels shall get HUSH SEALANT™ model HSAC-100 acoustical grade caulk at seams and all perimeter edges inside the curb.

4. System shall be plenum rated.

5. The combination of all layers shall be tested for Sound Transmission Loss in accordance with procedure ASTM E-90-10. The assembly shall be rated at not less than STC-49 with 1/3 octave performance values as listed below for sound radiation through the deck inside the curb.

EQUIPMENT SHALL BID AS AN ALTERNATE

Freq. (Hz)	80	125	250	500	1K	2K	4K	8K	STC
TL (dB)	17	25	39	51	59	62	67	74	49

6. Copy of test report by an accredited lab shall be included in the submittals to document the above performance.

7. The mechanical contractor shall provide evidence of the in-curb acoustical treatment installation prior to lowering of the rooftop unit to the acoustical manufacturer. The acoustical manufacturer shall issue a letter of certification stating that the products have been properly installed and sealed around all ductwork and drops to eliminate air gaps which can compromise performance.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.

2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.

3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."

D. Install separate devices furnished by manufacturer and not factory installed.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

EQUIPMENT SHALL BID AS AN ALTERNATE

F. Unless shown to come through roof curb to internal drain install drainpipes from unit drain pans to approved roof drain.

3.3 CONNECTIONS

A. Coordinate installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

B. Where installing piping adjacent to units, allow space for service and maintenance.

C. Gas Piping Connections:

1. Comply with requirements in Section 23 11 23 “Natural-Gas Piping."

2. Connect gas piping to furnace, full size of gas train inlet, and connect with union, pressure regulator, and shutoff valve with sufficient clearance for burner removal and service.

3. Install AGA-approved flexible connectors.

D. Coordinate duct installation requirements with schematics on Drawings and with requirements specified for duct systems.

E. Duct Connections:

1. Comply with requirements in Section 23 31 13 "Metal Ducts."

2. Drawings indicate the general arrangement of ducts.

3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."

F. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. A factory-authorized service representative shall perform startup service.
1. Complete installation and startup check according to manufacturer's written instructions.

2. Inspect units for visible damage to furnace combustion chamber.

3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:

a. Measure gas pressure at manifold.

b. Measure combustion-air temperature at inlet to combustion chamber.

c. Measure flue-gas temperature at furnace discharge.

d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.

e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-limit heat exchanger.
b. Alarms.

5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.

6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:

a. Cooling coil leaving-air, dry- and wet-bulb temperatures.

b. Cooling coil entering-air, dry- and wet-bulb temperatures.

c. Condenser coil entering-air dry-bulb temperature.

d. Condenser coil leaving-air dry-bulb temperature.

7. Simulate maximum cooling demand and inspect the following:

a. Compressor refrigerant suction and hot-gas pressures.

b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

1. Inspect casing insulation for integrity, moisture content, and adhesion.

2. Verify that clearances have been provided for servicing.

3. Verify that controls are connected and operable.

4. Verify that filters are installed.

5. Clean coils and inspect for construction debris.

6. Inspect operation of power vents.

7. Purge gas line.

8. Inspect and adjust vibration isolators and seismic restraints.

9. Verify bearing lubrication.

EQUIPMENT SHALL BID AS AN ALTERNATE

10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.

11. Adjust fan belts to proper alignment and tension.

12. Start unit.

13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.

14. Operate unit for run-in period.

15. Calibrate controls.

16. Adjust and inspect high-temperature limits.

17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.

18. Verify operational sequence of controls.

19. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.

    b. Return-air flow.

    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.
B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, and maintain units.

3.7 COMPLETION AND CLEANUP

A. Contractor shall comb and vacuum clean coils, inside and outside of unit cabinet prior to start-up.

EQUIPMENT SHALL BID AS AN ALTERNATE

B. Install temporary filters during construction and start-up period. Replace with specified filters at Substantial Completion.

3.8 PROTECTION OF FINISHED WORK

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation

END OF SECTION

EQUIPMENT SHAL BID AS AN ALTERNATE

SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART I -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.

B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).

C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.

D. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed locally at fan coil controller shall be available through building automation system.

E. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.

F. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

1.3 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.

1.4 SUBMITTAL:

A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule,

EQUIPMENT SHAL BID AS AN ALTERNATE

electrical characteristics and accessories being provided.

B. Provide line-by-line specification review annotated to certify compliance or deviation

C. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.

D. Product Data: Submit product data, including manufacturer's □product sheet for specified products.

1.5 WARRANTY

A. One (1) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.

B. Five (5) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.

C. One (1) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

PART 2 –PRODUCTS

2.1 UNIT CABINET:

A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.

B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Indoor and outdoor unit shall be of the same manufacturer.

2.2 COMPRESSOR

A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

2.3 COIL

A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.

B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless

EQUIPMENT SHAL BID AS AN ALTERNATE

copper tubes, which are cleaned, dehydrated, and sealed.

2.4 FANS

A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

2.5 AIR FILTERS

A. Unit shall have filter track with factory-supplied cleanable filters.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE:

A. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62° F to 84°F.

B. The unit shall have integral controls provided by unit manufacturer to perform input functions necessary to operate the system. Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms.

1. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed locally at fan coil controller shall be available through building automation system.

2. The unit shall be compatible with interfacing with connection to BACnet networks or interfacing with connection to BMS system.

C. The unit shall have the following functions as a minimum:

1. An automatic restart after power failure at the same operating conditions as at failure.

2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.

3. Temperature-sensing controls shall sense return air temperature.

4. Indoor coil freeze protection.

5. Wireless infrared remote control to enter set points and operating conditions.

6. Automatic air sweep control to provide on or off activation of air sweep louvers.

7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.

EQUIPMENT SHAL BID AS AN ALTERNATE

8. Fan-only operation to provide room air circulation when no cooling is required.

9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.

10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.

11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include dead band to prevent rapid mode cycling between heating and cooling.

12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

PART 3 -EXECUTION

3.1 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.

2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.2 STARTUP SERVICE

A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.3 CLEANING

A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 81 26

EQUIPMENT SHAL BID AS AN ALTERNATE

SECTION 23 82 19.13 - FAN COIL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes constant-volume fan coil units with coils for indoor installations.

B. Related Sections:

C. Electrical characteristics: Coordinate with electrical plans prior to submitting equipment; provide single point power connections.

D. Related Sections:

1. Section 23 05 00 - Common Work Results for HVAC.

2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.

4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.

5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.

6. Section 23 05 14 - Variable Frequency Controllers.

7. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

1.3 ACTION SUBMITTALS

A. Provide line-by-line specification review annotated to certify compliance or deviation.

B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.

C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.

D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

EQUIPMENT SHAL BID AS AN ALTERNATE

E. Product Data, Submit the following:

1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.

5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.

F. Manufacturer's Installation Instructions: Submit.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

C. Startup service reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.

2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

EQUIPMENT SHAL BID AS AN ALTERNATE

1. Comply with ASHRAE 15 for refrigeration system safety.

2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

A. The manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. **Warranty shall begin from date of Certificate of Substantial Completion**. Provide a sample of manufacturer's warranty certificates as described below within equipment submittal. **Warranty start dates from shipment or startup will not be accepted.**

B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for rooftop units. All components to be included such as but not limited to refrigerant, compressors, evaporator coils, condenser coils, electric heaters, gas-fired heaters, roof curbs, motors, starters, variable frequency drives, controls, etc. In the event of failure, the manufacturer shall provide a new motor, compressor, fan, evaporator coil, condenser coil, and controllers, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.

C. In addition to full machine parts, labor and refrigerant, the Standard warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.

D. The manufacturer shall provide factory certificates for each Rooftop Unit listing at a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "By Others". Extra materials shall be clearly labeled by unit

name in protective container and delivered to the Maintenance and Operations department for attic stock.

1. Filters: Four (4) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, new set at substantial completion and a set for attic stock. Filters shall be protected with polyester fabric at all times during construction. A list of all filter sizes and locations shall be turned over to the Owner at Substantial completion as part of the close-out documents.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

B. All equipment shall remain in manufacturer’s protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer’s original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

F. Protect units from physical damage. Leave factory covers in place until startup of machine.

PART 2 - PRODUCTS

2.1 FAN COIL UNITS

A. Manufacturers: Subject to compliance with scheduled efficiencies, capacities, and specification, provide products by the following manufacturers.

1. Refer to specification section 01 23 00 ALTERATES for list of acceptable manufacturers.

EQUIPMENT SHAL BID AS AN ALTERNATE

2. **All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.**

2.2 UNIT IDENTIFACTION REQUIREMENTS

A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:

- Project name and address.
- Unit identification as indicated within Contract Documents.
- Serial Number.
- Model Number.
- CFM.
- Entering and leaving air temperature (DB/WB) (cooling and heating coil).
- Entering and leaving water temperature (cooling and heating coil).
- Cooling and heating coil flow rate (GPM).
- Fan Motor Horsepower.
- Blower est. ext. sp. (in. wg.).
- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
- Sales Order #.
- Date of unit manufactured.

B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.3 MANUFACTURED UNITS

A. Fan coil units shall be factory assembled and consist of fans, motor and drive assembly, coils, filters, stainless-steel condensate pans and accessories.

2.4 CABINET

A. Materials: Formed singe-wall foil faced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections gasketed.

1. Outside Casing: 22-gauge, baked enamel, galvanized steel (G90).

2. Utility Lugs: For lifting unit and fastening to permanent structure, 8-gauge, galvanized steel (G90).

B. Cabinet Insulation: Comply with NFPA 90A or NFPA 90B.

1. Materials: Foil-Faced fiber glass insulation.

2. Thickness: 1 inch.

3. Density: 1 ½ pounds per cubic foot.

4. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
5. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.

EQUIPMENT SHAL BID AS AN ALTERNATE

C. Access Panels: Same materials and finishes as cabinet complete with threaded bolted fasteners, and gaskets. Inspection and access panels shall be sized and located to allow periodic maintenance and inspections. Provide access panels in the following locations:

1. Fan Section: Inspection and access panels.

2. Coil Section: Inspection panel.

3. Filter Section: Inspection and access panels to allow periodic removal and installation of filters.

D. Condensate Drain Pans: Formed sections of stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at maximum catalogued face velocity across cooling coil.

1. Double-Wall Construction: Fill space between walls with 1 inch, 1 ½ pound fiber glass insulation.

2. Drain Connections: Main and auxiliary on same side of fan. Provide auxiliary drain pan under unit above ceiling.

3. Float Switch: Provide a factory installed and wired drain pan float switch.

2.5 FAN SECTION

A. Fan-Section Construction: Direct drive centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior torsion flex mount and exterior spring vibration isolation.

B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access panels or doors to allow entry to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

2. Horizontal Flanged Split Housing: Bolted construction.

3. Drive Frame: Rail mounted, heavy gauge steel to allow frame to slide for easy belt tensioning.

C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.

D. Forward-Curved Fan Wheels: Galvanized-steel and/or aluminum/painted steel construction with inlet flange, back plate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically secured to flange and back plate; cast-steel hub swaged to back plate and fastened to shaft with set screws.

E. Coatings (exterior only): Baked Enamel

EQUIPMENT SHAL BID AS AN ALTERNATE

F. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished Stainless steel with keyway. Ship with a protective coating of lubricating oil.

2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

G. Pre lubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.

1. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.

H. Fan-Section Source Quality Control:

1. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

I. Inlet/outlet duct collars. Galvanized collars at each inlet and outlet of the unit. Flexible duct connection isolating discharge of scroll from discharge of fan.

2.6 MOTORS

A. General: Comply with requirements in Section 23 05 13 Common Motor Requirements for HVAC Equipment and Division 26. Matched with fan load.

B. Maximum Ambient Temperature Rating: 120 degrees F (50 degrees C).

2.7 COILS

A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.

B. Water Coils: Self-draining coil fabricated according to ARI 410.

1. Piping Connections: Sweat.

2. Tubes: Copper, .016-inch tube thickness.

3. Fins: Aluminum, 10 fins per inch.

4. Fin and Tube Joint: Mechanical bond.

5. Headers: Seamless copper tube with brazed joints.

6. Frames: Galvanized-steel channel frame.

a. Working-Pressure Ratings: 250 psig, 300 deg F.

7. Source Quality Control: Test to 500 psig underwater (2000 psig ultimate strength).

EQUIPMENT SHAL BID AS AN ALTERNATE

C. Refrigerant Coils: Coil designed for use with R-410a refrigerant, fabricated according to ARI 410, connected with soldered fittings.

1. Capacity Reduction: Circuit for Double control.

2. Tubes: Copper

3. Fins: Aluminum 10 fins per inch.

4. Fin and Tube Joint: Mechanical bond.

5. Suction and Distributor: Seamless copper tube with brazed joints.

6. Frames: 16 gauge, galvanized-steel channel frame.

7. Ratings: Design tested and rated in accordance to UL (UL recognized).

a. Working-Pressure Rating: 250 psig.

8. Source Quality Control: 500 psig underwater (2000 psig ultimate strength).

2.8 ELECTRIC HEATING (WHERE SCHEDULED)

A. Unit shall include an include electric heater consisting of electric heating coils, fuses, contactors, and a high temperature limit switch, with capacities as shown on the plans.

B. Electric heat shall have fully modulating capacity controlled by an SCR (Silicon Controlled Rectifier). A 0-10 VDC heating control signal shall be field provided to control the amount of heating.

C. Electric heating coils shall be located in the reheat position downstream of the supply fans.

2.9 FILTER SECTION

A. Filters: Comply with NFPA 90A.

B. Filter Section: Provide filter holding frames arranged for vertical orientations, with access panels on both sides of unit. Filters shall be removable from top or bottom access.

C. Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames.

1. Media: Fibrous material formed into deep-V-shaped.

2. Media and Media-Grid Frame: Nonflammable cardboard.

D. Replaceable Filter Media: MERV 13 or greater rating in accordance with ASHRAE Test Standard 52.2-2007.

EQUIPMENT SHAL BID AS AN ALTERNATE

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of steam, hydronic, direct expansion and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan coil units with the following vibration-control devices. Vibration-control devices are specified in Section 21 05 29 Vibration and Seismic Controls for HVAC Piping and Equipment.

B. Arrange installation of units to provide access space around fan coil units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to low profile fan coil units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans, to drainage piping. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 23 21 13 Hydronic Piping. Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

F. Condensate Piping: Comply with applicable requirements in Section 23 21 13 Hydronic Piping. Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

G. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 Refrigerant Piping. Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

H. Duct installation and connection requirements are specified in Section 23 31 00 HVAC Duct and Casings.

I. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

EQUIPMENT SHAL BID AS AN ALTERNATE

J. Ground equipment according to Division 26.

K. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.

2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.5 STARTUP SERVICE

A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.5 CLEANING

A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 82 19.13

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBSTITUTIONS OF PRODUCTS

A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided they meet the requirements of the particular project and are approved in an Addendum as a substitution prior to the submission of proposals.

B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each request shall provide the following

1. A specification line by line review annotated to certify compliance,
2. The name of the manufacturer and model, material or equipment for which it is to be substituted
3. A complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation.

The Engineers decision of approval or disapproval of a proposed substitution shall be final.

C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.

D. The Engineer and Owner reserve the right to reject the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.

E. Availability of specified items:

1. Verify prior to submittal of Proposal that all specified items will be available intime for installation during orderly and timely progress of the work.

2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.

3. The request will not be considered if the Contractor’s failure to pursue the work promptly or coordinate activities properly results in the product or method not being provided.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.

F. A request constitutes a representation that Offeror:

1. Has investigated the proposed product and determined that it meets or exceeds the quality level of specified product.

2. The Substitution will be provide the same warranty as the specified product, except when inability to provide specified Warranty is the reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

G. **No substitutions will be considered after the Award of Contract.**

1.3 SUMMARY

A. All work for electrical systems as required in the project shall be properly installed and tested to perform their intended function.

1.4 QUALITY ASSURANCE

A. Perform all work in accordance with the latest edition of the National Electrical Code, and local codes.

B. All electrical materials and distribution, and utilization equipment shall be UL Listed.

C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.

D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.5 COORDINATION WITH OTHER TRADES

A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system shall be installed at the proper time and fit the available space.

B. Locate and size all openings with the work of other trades as required for the proper installation of the electrical system components.

C. Make all electrical connections to all equipment furnished by this division and any other division.

D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.6 DRAWINGS

A. The drawings are schematic in nature; however they show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.

B. The Electrical Drawings are diagrammatic in character and cannot show every connection or conduit in its exact location. These details are subject to the requirements of ordinances as well as structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out to be concealed in furred chases and suspended ceilings, etc., when located in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid the crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts the systems shall be physically arranged to fit in the space available at the elevations intended and with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.7 SUBMITTALS

A. Specification Review:
   1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.8 EXISTING CONDITIONS

A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.

B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.

C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging and labeled with manufacturer's identification.

B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before the time of installation. Limit the shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

A. Provide allowance in bid for the following items
   1. Twenty-five (25) 20A/1P circuits, each 100 feet in length from source, for use as required during construction. Include one duplex receptacle per circuit

   2. Twenty-five (25) light switching circuit drops, each twenty feet in length for use as required during construction. Include one 277V light switch per circuit

   3. Ten (10) additional exit signs for use as required during construction.

   4. Items shall be provided with all associated labor and necessary accessories (conductor, conduit, supports, etc.) required for proper installation.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary wiring and connections to maintain existing systems in service during construction.

C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.

D. Remove, relocate, and extend existing installations to accommodate new construction.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 OWNER INSTRUCTION

A. Provide on-site Owner training for all new equipment.

B. The Operation and Maintenance manuals and actual equipment installed shall be used as the basis for instruction.

C. At the conclusion of the on-site training program require the Owner personnel to sign a written certification indicating they have completed the training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a complete system of building wire and cable for all electrical loads.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Provide stranded conductors for all wiring.
   2. Conductors not smaller than 12 AWG for power and lighting circuits.
   3. Conductors not smaller than 16 AWG for control circuits.
   4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
   5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
   6. Copper.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only Type THHN/THWN-2 insulation, in raceway.

C. Branch Circuit Conductors: No branch circuit conductors are allowed in or under any slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

A. Where wire and cable destinations are indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:
   1. Southwire
   2. Republic
   3. Alan
   4. Encore

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation: NFPA 70; Type THHN/THWN-2 insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

A. **Acceptable Use**: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.

B. Manufacturers:
1. Atkore
2. Southwire

C. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.

D. Comply with NEC 320.

E. Support: Provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.

F. Provide an insulated green grounding conductor in all Type AC cable.

G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage wire and cable has been completed.

C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

A. Remove exposed and abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire, cable and conduit. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.

C. Provide access to existing to remain wiring connections and requiring access. Modify installation or install access panel.

D. Extend existing circuits using materials and methods compatible with existing electrical installations or as specified.

3.3 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
   b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
   c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
3. Tape uninsulated conductors and connectors with electrical tape rated to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				**Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)**	
System/Phase	**A**	**B**	**C**	**N**	**G**	**IG**
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.

2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.

3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.

4. Color indicated is based on accepted standards. Contractor is to verify and provide colors as required by the local authority.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

A. Limit the number of current carrying conductors per conduit to 3. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.

B. Grouping different voltages is not allowed.

C. Provide metal box sizes per NEC Table 314.16 (A).

D. Provide conduit per NEC Annex C.

E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed exposed in finished spaces and spaces without a ceiling.

B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other “hard” (non-lay-in) ceiling types of construction.

C. Labeling: Provide labels on all junction boxes.
1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system’s wiring name.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:
   1. Metal underground water pipe.
   2. Metal building frame.
   3. Concrete-encased electrode.
   4. Ground ring.
   5. Rod electrode.
   6. Plate electrode.

1.5 SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

A. This paragraph shall apply to buildings when a ground ring is specified.

B. Convene minimum one (1) week prior to commencing work of this section.

C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

A. Convene prior to cover up of work of this section.

B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts
6. VFC

B. Product Description:
1. Material: Copper-clad steel
2. Diameter: 3/4 inch
3. Length: ten (10) feet

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: #2 AWG.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare.

2.3 MECHANICAL CONNECTORS

A. Manufacturers:
1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. ILSCO Corporation
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical
7. VFC

B. UL Listed for grounding applications.

C. Provide “ACORN” style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.

D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Manufacturers:
1. Cadweld by Erico, Inc.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 GROUNDING BUSSES

A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Seriess two (2) inch insulators.
7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

2.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

A. Eight (12) inch diameter concrete pipe with belled end.

B. 24 inches long or longer to reach ground and set flush in grade.

C. Provide cast iron cover with "GROUND" embossed on top.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

A. Modify existing grounding system to maintain continuity to accommodate renovations.

B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

A. Install in accordance with NEC Article 250 Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment. Route the grounding electrode conductor to, and bond to, the grounding electrode system. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.

B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.

C. Install grounding and bonding conductors concealed from view.

D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.

E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.

F. Transformers: Ground as a separately derived source.
1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
2. Size bonding jumper per NEC Table 250.66.
3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.

G. Bond together reinforcing steel and metal accessories in pool and fountain structures.

H. Concrete-Encased Electrode (NEC 250-52):
1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless other wise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.

I. Made Electrode:
1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
3. Install grounding electrode conductor of 3/0 Copper.

J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.

K. Grounding Busses:
1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
2. Provide in each IDF and MDF room.
3. Provide at each CATV / MATV head-end mounting board.
4. Provide at each building communications rack.
5. Provide at each sound reinforcement equipment rack.

L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.

M. Metal Building Frame NEC 250-52.
1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.

N. Ground Ring Electrode (NEC 250-52):
1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.

O. Fuel Gas Piping:
1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuos and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
2. Gas piping shall not be used as a grounding electrode.

P. Engine Generator Neutral:
1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.

Q. Outdoor Lighting Poles:
1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

A. General Check the drawings for special grounding system or grounding requirements.

B. Telephone and data equipment grounding connections:
1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.

C. Other Buildings Served From Common Service:
1. The main building service is the source for electric service to several out buildings on site.
2. Isolate neutral bus from ground at each out-building main panel.
3. Provide an equipment grounding conductor in feeder to each out-building main panel.
4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

3.6 EQUIPMENT GROUNDING SYSTEM

A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.

B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

A. Grounding Tests:
1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
2. Provide written test report to document all findings, test values, work done and certification of grounding system.
3. Use true-RMS meters for all voltage and current measurements.
4. Test telecommunications grounding riser to verify continuity.
5. Check all isolated ground receptacles for correct polarity.
6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
8. Verify continuity and isolation of audio system ground bus and grounding riser.
9. Perform ground resistance and continuity testing in accordance with IEEE 142.
10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
   1. Designated Ground Rods:
      a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
      b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

1.3 REFERENCES

A. Underwriters Laboratories Inc.:
1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

A. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company
3. O-Z Gedney Co.
4. Appleton

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division
4. Unistrut Corp.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.

B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.

C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.

D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products .
6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

B. General:
1. Furnish UL Listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

C. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:
1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place intumescent coating in sufficient coats to achieve rating required.

F. Remove dam material after firestopping material has cured.

G. Fire Rated Surface:
1. Seal opening at all rated floors and walls as follows:
a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
c. Pack void with backing material.
d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product ins accordance with manufacturer's instructions.

H. Non-Rated Surfaces:
1. Seal opening through non-fire rated floors and walls as follows:
a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Provide mechanical sleeve seals.

B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
   2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
   3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
   3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
   5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.

C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.6 COORDINATION

A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.

B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.

C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.

D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:
1. Carlon Electrical Products
2. Hubbell Wiring Devices
3. Thomas & Betts Corp
4. Walker Systems Inc.
5. The Wiremold Co.
6. Multi Cell
7. O-Z Gedney
8. Raco.
9. or approved equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit

E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.

F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.

G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.

H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
   1. Manufacturer:
      a. Ocal Inc.
      b. Perma Cote Industries
      c. Rob-Roy Industries
      d. or Approved equal.

I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.

J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
   1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
   2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.

B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.

C. Construction:
   1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
   2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
   3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
   4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. “Quazite” or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.2 WIREWAY

A. Manufacturers: Same as Metal Conduit.

B. Product Description: General purpose.

C. Size: As determined by Contractor in accordance with NEC 376.

D. Cover: Screw cover.

E. Connector: Slip-in.
F. Fittings: Lay-in type.

G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.3 OUTLET BOXES

A. Manufacturers: Same as Metal Conduit.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer.

D. Wall Plates: As specified in Section 26 27 26.

2.4 FLOOR BOXES

A. UL listed for wet application, watertight cast-iron, scrub-shield compliant.

B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
1. Floor: Fully adjustable before and after pour.
2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
4. Multi Gang Floor Box: Provide a minimum of a 4-gang on grade floor box Wiremold evolution #RFB series. Or approved equal by engineer. Acceptable manufacturer equals shall be from Appleton, Carlon, Crouse-Hinds, Hubbell or FSR. Floor box shall be provided with two duplex receptacles, (1) 3/4” conduit for power and (1) 1-1/2” conduit for data. Conduits shall be routed from the floor box to the nearest full height wall and up to the accessible ceiling plenum. Provide with pull string. Data conduits shall be routed from the floor box to the wall with the AV backbox for TV and from backbox in wall to the accessible ceiling plenum no daisy chain of low voltage conduits is allowed. Refer to Architect for exact location, cover types and finish prior to installation and procurement. Refer to submitted electrical power floor plan keyed notes for specific floor box types and locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION - RACEWAY

A. Ground and bond raceway and boxes in accordance with Section 26 05 26.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.

C. Identify raceway and boxes in accordance with Section 26 05 53.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

F. Arrange raceway supports to prevent misalignment during wiring installation.

G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.

I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

J. Do not attach raceway to ceiling support wires or other piping systems.

K. Construct wireway supports from steel channel specified in Section 26 25 29.

L. Route exposed raceway parallel and perpendicular to walls.

M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.

O. Maintain clearance between raceway and piping for maintenance purposes.

P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.

Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.

R. Bring conduit to shoulder of fittings; fasten securely.

S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.

U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.

V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.

X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

AA. Close ends and unused openings in wireway.

BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.4 RACEWAY TYPES

A. The following raceway types are to be used in the following locations:
   1. Under Slab on Grade: Schedule 40 PVC.
   2. Outdoor Locations, Above Grade: Rigid galvanized steel.
   3. Wet and Damp Locations: Rigid galvanized steel.
   4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
   5. Underground:
      a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs, parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
      b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6” above raceway.
   6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
   7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.

8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.

B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Do not fasten boxes to ceiling support wires or other piping systems.

G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18” of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.

H. All outdoor boxes shall be UL listed for wet location service.

I. Provide rigid support to structure for all junction boxes.

J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.

K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.

L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.

M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.6 ADJUSTING

A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

3.8 INSTALLATION - FLOOR BOXES

A. Use cast floor boxes for installation in slab on grade.

B. Set floor boxes level.

C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.9 ADJUSTING

A. Adjust floor box flush with finish material.

3.10 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

A. Labeling: Provide label on all above ceiling junction boxes.
   1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

B. Color Code: All Electrical junction boxes above ceiling shall be colored as follows.
   1. Yellow for 277V lighting
   2. Blue for 120V regular power
   3. Green for 120V computer power
   4. Brown for 277/480V equipment
   5. Red for emergency power

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Underground Warning Tape.
   3. Lockout Devices.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and standards: Comply with the following:
   1. National Electrical Code, NFPA No. 70.
   2. NEMA standards applicable to the product provided.
   3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
   1. Panduit Corp.
   2. American Labelmark Co.
   3. Markal Corp.
   4. Calpico, Inc.
   5. Ideal Industries, Inc.

2.2 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.

C. Letter Size:
   1. 1/4 inch high letters for identifying individual equipment and loads.

D. Minimum nameplate thickness: 1/8 inch.

2.3 UNDERGROUND WARNING TAPE

A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
4. Secure nameplate to equipment front using screws, rivets, or adhesive.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:
    a. Switchboards
    b. Panelboards
    c. Transformers
    d. Service Disconnects
        1) Enclosed Switches
    e. Motor Control Centers
    f. Stand-alone Motor Controllers
    g. Generators
    h. Contactors

C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
2. Install line marker for underground wiring, both direct buried and in raceway.

D. Printed Panelboard Directory:
1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
3. Copy in Owner’s Manual.

3.3 ABOVE CEILING JUNCTION BOXES

A. Labeling: Provide label on all above ceiling junction boxes.
   1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

F. SCCR: Short-circuit current rating.

G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data: Submit information regarding computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals [**shall**] [**may**] be in digital form:

1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:
   1. For Power Systems Analysis Software Developer.
   2. For Power System Analysis Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Arc-Flash Hazard Analysis:
   1. Provide final arc-flash hazard analysis report in hard copy and digital format.
   2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
   3. Provide library files for power system analysis software used to perform study.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
   1. Computer program shall be designed to perform arc-flash analysis.

E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.

F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
   1. CGI CYME.
   2. Power Analytics, Corporation.
   3. <**Insert manufacturer's name**>.

B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.

C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, indicating the following:
   1. Protective device designations, locations, and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.
   6. Utility sources.

D. Study Input Data: As described in "Power System Data" Article.

E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."

F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.

G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.

H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.

I. Arc-Flash Study Calculations and Output Reports:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc-flash boundary.
   5. Restricted approach boundary.
   6. Limited approach boundary.

7. Working distance.
8. Incident energy.

J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
1. Minimum Size: 6 inches (150 mm) wide by 4 inches (100 mm) high.
2. Sample label submitted for review prior to printing of actual labels.

B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
1. Equipment ID.
2. Nominal voltage.
3. Protection boundaries.
   a. Arc-flash boundary.
   b. Restricted approach boundary.
   c. Limited approach boundary.
4. Available incident energy.
5. Working distance.
6. Engineering report number, revision number, and issue date.

C. Completely machine printed, no field-applied markings.

D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.

B. Study all operating scenarios to determine the maximum incident energy at each location.

C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all

locations in electrical distribution system where personnel could service or examine equipment while energized.

D. Include all three-phase medium- and low-voltage equipment locations.

E. Calculate the limited and restricted approach boundaries for each location.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.

G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance or available short-circuit current at each service.
3. Short-circuit current at each system bus (three phase and line to ground).
4. Voltage level at each bus.
5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.

6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower.
12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

A. Apply [**one**]arc-flash label on the front cover [**of each section of the equipment**] [**and on side or rear covers with accessible live parts and hinged doors or removable plates**] for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:
1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Low voltage transformers.
6. Panelboard.
7. Safety switch.
8. Fused disconnect switch.
9. Enclosed circuit breaker.
10. Adjustable frequency drive.
11. Control panel.
12. <**Insert any other equipment that could be serviced or examined while energized**>.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION 26 05 73.19

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 26.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the owner will manage the commissioning process.

1.3 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.4 SUMMARY

A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.5 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.6 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the OWNER’s Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the OWNER and the Commissioning Agent.

B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.7 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the OWNER Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION 26 08 00

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

1.3 SUBMITTALS

A. Product Data: Submit dimensions, size, voltage ratings and current ratings.

B. Short circuit current rating (SCCR) of equipment.

C. U.L. Label.

D. Electrical characteristics of equipment.

E. Enclosure metal gauge and finish.

1.4 CLOSEOUT SUBMITTALS

A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.

B. Manufacturers:
1. ASCO
2. Square D
3. GE

C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.

D. Lighting Contactors:
1. Mechanically held, electrically operated.
2. ASCO 918 or approved equal.
3. Provide ASCO Accessory 47 for two-wire control of contactor. Provide time switch and photocell to control contactor.

4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.

E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

2.2 PHOTO-ELECTRIC CONTROLS:

A. Description:
1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.
5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
9. Listing: Photocell shall be listed by Underwriters Laboratories.

B. Manufacturer: Intermatic, Paragon, Precision, Tork.

2.3 TIME CLOCKS:

A. Manufacturer:
1. Grasslin
2. Intermatic
3. Paragon
4. Precision
5. Tork

B. General: Provide time clocks similar to Intermatic Series T 1900 or Tork B8000 Series. Provide wiring to photocells, contactors, relays or other control points as required.

C. Contacts: Rated for 20 amps minimum at 277 volts. Provide 1, 2, 3 or 4 pole, single or double throw, maintained or momentary contact, as required based on the time clock function and the number of branch circuits controlled. Contacts shall be horse power rated when motors are switched.

D. Dial: Provide 24-hour dial with 15 minute intervals minimum. Dial shall permit at least 48 ON/OFF cycles per day via 96 adjustable tabs. Dial shall include a skip-a-day wheel and two day-omitting pins. Provide extra trippers and day-omitting pins if required.

E. Special Dials: Provide special dial where indicated on drawings or in these specifications. Provide astronomic dial for time clock controlling outdoor lighting.

F. Timing Motor: Provide heavy duty synchronous timing motor, self-starting and permanently lubricated. Motor shall be permanent magnet type for high torque and operate through and ambient temperature range of - 30 degrees Fahrenheit to + 130 degrees Fahrenheit. Motor cover shall have a viewing window to check for rotation of gears. Motor voltage shall be 120, 208, 240 or 277 volts as required.

G. Reserve Power: Provide a spring driven reserve power drive to operate time clock for at least ten (10) hours after a power failure.

H. Manual Bypass:
1. Time clock shall include a manual ON/OFF bypass switch capable of overriding time schedule without disturbing trippers or timing sequence.
2. Time clock shall be installed with a pilot-light SPST toggle switch mounted in a separate, adjacent single-gang box. Switch shall be labelled "Bypass" and shall function to turn ON circuit(s) controlled by the time clock. Switch shall be flush or surface mounted to match time clock housing.

I. Terminals: Time clock shall have a terminal block with screws for line, load, and grounding connections with up to AWG #8 wire. Provide a removable dead-front terminal cover within the time clock case. Timing motor shall have separate, unswitched terminals.

J. Enclosure: Provide a NEMA 1 enclosure with hasp suitable for padlock and side-hinge door for all clocks located indoors. Enclosure shall have 1/2 inch and 3/4 inch knockouts in bottom and sides. Provide NEMA 4X for those located outdoors and in wet areas.

K. Nametag: Provide a nametag for each time clock stating load controlled; see Section 26 05 53, Electrical Identification.

L. Listing: All time clocks shall be listed by Underwriters Laboratories and C.S.A.

M. Manuals: Provide three sets, each consisting of operating instructions and one-line diagrams.

****
Specifier's Note: Edit for each Job.
****

2.4 DIGITAL TIME SWITCHES:

A. Recessed in wall: WattStopper TS-400 or approved equal.

1. The digital time switch shall be programmable to turn lights off after a preset time.

2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.

3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.5 OCCUPANCY SENSORS:

A. Ceiling Sensors: Require power packs
   1. UT-3000-3- Low voltage ultrasonic ceiling mounted with 2000 square foot coverage. Typical for large restroom.
      DT-300- Low Voltage dual technology ceiling mounted with isolated contact. Typical for classrooms.
   2. WT-2250/2255- Typical corridor sensor- Low voltage ultrasonic ceiling mounted with 10' by 90' coverage pattern

B. Wall Switch Sensors:

DSW-301- Line voltage dual technology wall switch sensor for 1 circuit. Typical for large office or conference room.
DW-100-24- Low voltage dual technology wall switch sensor. Requires Power Pack
DSW-302- Line voltage dual technology wall switch sensor for 2 circuits
DW-311 – Line voltage dual technology wall switch sensor with 0-10V dimming

1. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180˚ coverage capability.
3. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
4. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
5. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
6. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

C. Power and Auxiliary Packs:

1. BZ-150- Power pack for use with low voltage sensors when using a manual on function. 225ma

D. High Ceiling Applications

1. HB-350B*LENS Low Voltage PIR sensor
2. L1 Lens- 20' x 60' coverage pattern when mounted at 40'
3. L3 Lens- 40' diameter coverage pattern when mounted at 40'
4. L4 Lens- 60' diameter coverage pattern when mounted at 60'

E. Passive infrared sensors:

1. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
2. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
3. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
4. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

F. Dual technology sensors:

1. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

G. Ultrasonic sensors:

1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002%

tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

H. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

I. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

J. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.

K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

N. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

O. All sensors shall have UL rated, 94V-0 plastic enclosures.

P. All occupancy sensors shall be set to maximum 30 minute time delay.

Q. Provide minimum 5% spare sensors for owner stock of each type of occupancy sensor.

****
Specifier's Note: Edit for each Job.
****

2.6 DAYLIGHT HARVESTING – Wattstopper LightSaver® LS-301 Daylighting Sensor

A. The photosensor shall be a self-contained, ceiling-mounted daylighting control device that detects changes in light levels and raises or lowers electrical lighting in response.

B. The photosensor shall be a low voltage device, powered by 24 VDC voltage supplied by a power pack.

C. The photocell shall have an extremely linear response with greater than 1% accuracy over the sensed range.

D. The photosensor shall be capable of controlling up to 50 standard 0-10VDC electronic dimming ballasts.

E. The photosensor shall utilize an internal photocell that measures only in the visible

spectrum and has a response curve that closely matches the photopic curve. The photocell shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.

F. The photosensor shall provide dimming over the full range from .2 VDC to 10 VDC. When maximum dimming is required, a .2 volt output is supplied to the ballast; when full output lighting is required, a 10 volt output is supplied to the ballast.

G. The photosensor shall use a sliding setpoint algorithm. The photosensor shall maintain the desired task level illuminance for current daylight contribution based on two setpoints, a night setpoint and a day setpoint.

H. All setup adjustments shall be made remotely from the photosensor by means of a wireless, infrared handheld remote. All setup adjustments shall be done from the ground with no ladders required after the initial installation has been completed.

I. The photosensor shall be controllable by a compatible handheld remote that allows an occupant to adjust the light level to their preference while enabling the automatic dimming to continue to achieve the adjusted setpoint. Any adjustment made with the handheld remote shall be easily canceled by pressing one button on the remote.

J. The photosensor shall have a control range of 20-60 footcandles.

K. The photosensor shall not protrude more than 0.75 inches from the ceiling and should blend in aesthetically.

L. To ensure quality and reliability, photosensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

M. The photosensor shall have a standard five year warranty.

2.7 SPORTS LIGHTING CONTROL STATION

****
Specifier's Note: Edit for each Job.
****

A. General: Provide pushbuttons for manual override of programmable relays designated to control the power contactors for the outdoor sports lighting at each field. Arrange pushbuttons into a single enclosure for each field.

B. Enclosure: Enclosure shall be NEMA 4X stainless steel or polycarbonate with gasketing for outdoor wet locations.

C. Pushbutton: Similar to Square D Class 9001-Type B, Type BW245, NEMA 4, momentary contact, RED/ON and GREEN/OFF pushbuttons with collar guard.

D. Wiring: From each pushbutton in the Sports Lighting Control Station, provide low voltage wiring to the programmable relay cabinet.

E. Control: BAS schedules all power contactors for outdoor sports lighting via the programmable relay system. Each sports field shall have a programmable relay assigned to the contactors for the sports lighting of that field. BAS will program automatic schedules

for the sports lighting as required. User shall be able to override automatic schedule from BAS with manual ON/OFF signals from the pushbutton Lighting Control Stations. Pushbutton signals relay cabinet, similar to a classroom light switch, and relay causes the lighting contactors to change state (OFF to ON, ON to OFF).

F. Engraving: Provide engraved lamacore plate above each pushbutton describing the lighting it will control. Example: TENNIS COURTS; FOOTBALL-EAST POLES, FOOTBALL-WEST POLES, BASEBALL, SOFTBALL.

G. Relays: For each pushbutton control, provide a relay in the local relay cabinet nearest the sports lighting contactors. Wire relay to the control circuits of the associated sports lighting contactors. Program BAS for both automatic scheduling of the sports lighting and to accept manual override from pushbutton Sports Lighting Control Stations.

PART 3 - EXECUTION

3.1 PHOTO-ELECTRIC CONTROL MOUNTING:

A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.2 TIME CLOCK PROGRAMMING:

A. Install time clock and photocell for ON by photocell at dusk, OFF by time clock at midnight, then ON by time clock at 5:00 a.m. and OFF by photocell at dawn. Program time clock ON/OFF times to other time(s) when indicated on Drawings.

3.3 INSTALLATION

A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".

B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.

C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

END OF SECTION 26 09 23

SECTION 26 09 43 - DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Distributed Digital Lighting Control System: System includes
   1. Digital Lighting and Plug Load Controls
   2. Relay Panels
   3. Emergency Lighting Control.

1.2 RELATED SECTIONS

A. Section 27 10 00 – Structured Cabling System

B. Section 26 50 00 - Lighting

C. Section 23 09 23 – Direct Digital Controls

D. Section 23 09 93 – Sequence of Operation for HVAC Controls

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. NEMA - National Electrical Manufacturers Association

C. FCC emission standards

D. UL - Underwriters Laboratories, Inc. Listings

E. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.

F. UL 20 - General Use Switches, Plug Load Controls

G. UL 924 - Standard for Emergency Lighting and Power Equipment

H. ULC - Underwriter Laboratories of Canada Listings

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Lighting Control System shall accommodate the square-footage coverage requirements for each controlled area, utilizing room controllers, plug load controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets for each product to be used, including:
   1. Catalog sheets and specifications.
   2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   3. Storage and handling requirements and recommendations.
   4. Installation instructions.

C. Shop Drawings: Wiring diagrams for the various components of the System specified including:
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
   2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on the reflected ceiling plans.
   3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
   4. Network riser diagram including floor and building level details. Riser shall illustrate points of connection to integrated systems and coordinate integration with mechanical and/or other trades. Network cable specification shall be included.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Closeout Submittals:
   1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
   2. Operation and Maintenance Manual:
      Include the following
      a. Approved Shop Drawings and Product Data.
      b. Sequence of Operation, identifying operation for each room or space.
      c. Manufacturer's maintenance information.
      d. Operation and Maintenance Data with detailed information on device programming and setup.
      e. Startup and test reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.7 PRE-INSTALLATION MEETINGS

A. Convene the meeting a minimum of two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:
   1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
   2. Review the specifications for low voltage control wiring and termination.
   3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
   4. Discuss requirements for integration with other trades

C. Inspect and make notes of job conditions prior to installation:
   1. Record minutes of the conference and provide copies to all parties present.
   2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
   3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install equipment until the following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.10 WARRANTY

A. Products Warranty: Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

1.11 MAINTENANCE

A. Spare Parts:
   1. Provide 5% spares of each product listed below to be used for maintenance. Electrical Contractor shall deliver items to Owner within 30 days of substantial completion.
      a. Room Controllers
      b. Occupancy Sensors
      c. Emergency Bypass controllers
      d. Low voltage switches
      e. Daylighting harvesting photocells

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturer: Signify (basis of design), Acuity

B. Substitutions must meet performance requirements of this section 26 09 43.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. System General: Provide a Distributed Lighting Control System complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified between

the Drawing and this Specification, contact the Architect for clarification prior to proceeding.

1. Daylit Areas: Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
    a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
    b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
    c. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.
    d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if the system functions to turn lights back on at dimmed level, rather than turning full-on prior to dimming.

B. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.

1. Digital lighting control local network (DyNet): RS-485 based, plug-in wiring system (Cat 5e) for power and data to room devices.
2. Plenum-rated controllers for on/off and 0-10V dimming control.
3. Digital Occupancy Sensors: digitally addressable, calibrated occupancy sensors with infrared (IR) communications.
4. Digital Switches: digitally addressable pushbutton on/off, dimming, and scene switches.
5. Configuration Tools: Handheld remote for load and scene control using infrared (IR) communications to digital devices.
6. Programming and Configuration Software: Optional PC-native application capable of accessing control parameters within a room, for the local network, via a USB adapter.
7. Automatic Load Control Relays (ALCR's): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

2.3 DIGITAL LOAD CONTROLLERS (ROOM, PLUG LOAD AND FIXTURE CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without the use of software. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/potentiometers. Control units shall include the following features

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement using the default configuration capabilities, a room controller may be replaced with an off-the-shelf device with only needing to use the on-device configuration button.
3. Multiple load controllers connected together in a local network must automatically arbitrate with each other, without any specialized software
4. Service LED to indicate:
    a. Data transmission
    b. Output Type
    c. Emergency Mode Active
5. Quick installation features including:
    a. Standard junction box mounting
    b. Quick low voltage connections using standard RJ-45 patch cable

6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
   a. Turn on to 100 percent
   b. Turn off
   c. Turn on to last level
7. Each load be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off (Follow on and off)
   b. Manual-on/Auto-off (Follow off only)
8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:
   a. Load status
   b. Schedule state, normal or after-hours
   c. Demand Response enable and disable
   d. Room occupancy status
   e. Total room lighting and plug loads watts
   f. Electrical current
   g. Total watts per controller
   h. Total room watts/sq ft.
   i. Force on/off all loads
10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Zero cross circuitry for each load
13. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
14. Dimming Room Controllers shall share the following features:
   a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
   b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
   c. The following dimming attributes may be changed or selected using a wireless configuration tool:
      1) Establish preset level for each load from 0-100 percent
      2) Set high and low trim for each load
      3) Initiate lamp burn in for each load of either 0, 12 or 100 hours
   d. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
   e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
   f. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
   g. All configurations shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

B. On/Off/0-10V Dimming KO Mount Room Controllers shall include:
   1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
   2. Optional real time current and voltage monitoring (with - M Monitoring option).

3. Two RJ-45 local network ports.
4. One dimming output per relay
   a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting
5. Dynalite product number: DDC116-UL.

2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Digital Occupancy Sensors features shall include the following:
   1. Digital calibration and configuration for the following variables:
      a. Sensitivity, 0-100 percent in 10 percent increments
      b. Time delay, 1-30 minutes in 1 minute increments
      c. Test mode, Five second time delay
      d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
   2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the local network.
   3. Programmable control functionality including:
      a. Each sensor may be programmed to control specific loads within a local network.
      b. Sensor shall be capable of activating a user-definable lighting scenes.
      c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
      d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      e. Ultrasonic and Passive Infrared
      f. Ultrasonic or Passive Infrared
      g. Ultrasonic only
      h. Passive Infrared only
      i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
   4. One or two RJ-45 port(s) for connection to local network.
   5. Infrared (IR) receiver to allow remote operation via handheld remote controls.
   6. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
   7. Manual override of controlled loads.
   8. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

B. Multiple occupancy sensors may be installed in a room by simply connecting them to the local network. No additional configuration will be required.

C. Dynalite product numbers: DUS804CS-UP, DUS360CR

2.5 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in multiple button configurations. Wall switches shall include the following features:
   1. Infrared (IR) receiver for use with handheld remote controls.
   2. Removable buttons for field replacement with engraved buttons and/or alternate color

buttons. Button replacement may be completed without removing the switch from the wall.
3. Configuration LED on each switch that blinks to indicate data transmission.
4. Load/Scene Status LED on each switch button with the following characteristics:
   a. Bi-level LED
   b. Dim locator level indicates power to switch
   c. Bright status level indicates that load or scene is active
   d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
5. Programmable control functionality including:
   a. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. Two RJ-45 ports for connection to local network.

C. Multiple digital wall switches may be installed in a room by simply connecting them to the local network.

D. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.
1. Individual button function may be configured to Toggle, On only or Off only.
2. Individual scenes may be locked to prevent unauthorized change.
3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
4. Ramp rate may be adjusted for each dimmer switch.
5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
6. Dynalite product numbers: DS1SRA-W-DN, DS2SRA-W-DN, DS3SRA-W-DN, DS4SRA-W-DN, DS5SRA-W-DN, DS1S2ZRA-W-DN, DS1S4ZRA-W-DN, DS2S4ZRA-W-DN Available in white; compatible with wall plates with decorator opening.

2.6 DIGITAL DAYLIGHTING SENSORS

A. Occupancy sensors shall contain integral daylighting sensors and shall work with load controllers and relay panels to provide automatic dimming daylight harvesting capabilities for any load type connected to the controller or panel.
1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone

B. Digital daylighting sensors shall include the following features:
1. Sensor's internal photodiode shall only measure light waves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 5-5000 LUX.
3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled

zone, depending on the selection of load controller(s) and load binding to controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For \daylight harvesting dimming, the photosensor shall provide the option, , to turn off or dim lights to a field-selectable minimum level when the daylight contribution is sufficient
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
9. Configuration LED status light on device that blinks to indicate data transmission.
10. One RJ-45 port for connection to DLM local network.
11. A choice of accessories to accommodate multiple mounting methods and building
12. Any load or group of loads in the room can be assigned to a daylighting zone
13. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
14. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
15. Dynalite Product Number: DUS804CS-UP, DUS360CR

2.7 HANDHELD INFRARED REMOTE CONTROL

A. Provide an infrared remote control tool to facilitate wireless control of IR enabled devices.

B. Features and functionality of the IR remote tool shall include but are not limited to:
1. One-way infrared (IR) communication with IR-enabled devices within a range of approximately 30 feet.
2. Allow user to select scenes, ramp lighting levels, or trigger tasks

C. Dynalite Product Numbers: DTK512

2.8 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all Dynalite products, including all parameters. Software shall be capable of accessing room-level parameter information locally within the room when connected via the optional PD-PCN USB programming adapter.

B. Additional parameters exposed through this method include but are not limited to:
1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after-hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.

5. Separate normal hours and after hours per-load buttons with modes including: Do nothing, on only, off only, on and off.
6. Load control polarity reversal so that on events turn loads off and vice versa.
7. Per-load DR (demand response) shed level in units of percent.
8. Load output pulse mode in increments of 1second.
9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
1. Device list report: All devices in a project listed by type.
2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
5. Device parameter report: Per-room lists of all configured parameters
6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
7. Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.

D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
1. Set, copy/paste an entire project site of sensor time delays.
2. Set, copy/paste an entire project site of sensor sensitivity settings.
3. Search based on room name and text labels.
4. Filter by product type to allow parameter set by product.
5. Filter by parameter value to search for product with specific configurations.

E. WattStopper Product Number: PD-PCN USB commissioning device, System Builder application

2.9 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Units – Where required by code or specified on the drawings the following devices shall be provided
1. A UL 924 listed device that monitors the switched and unswitched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. The lighting is only powered by the emergency lighting circuit. Upon normal power failure the emergency lighting circuit will close and force the emergency lighting ON to full brightness overriding any dimming control signal until normal power is restored. Bodine Product Numbers: BLCD-20B, BLCD16DIM

2. A UL 1008 list device that monitors the unswitched circuit providing normal lighting in the area. The unit provides normal ON/OFF control of the emergency lighting. The lighting may be powered by either the switched normal or the unswitched emergency power. Upon normal power failure the unit will transfer from normal switched power to unswitched emergency power and force the emergency lighting ON to full brightness overriding any dimming control signal until the normal power is restored. Bodine Product Number: GTD20A

Both shall include the following features::

1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

PART 3 EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that the required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.

1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
2. Low voltage wiring topology must comply with manufacturer's specifications.
3. Document all device locations and wiring on as built drawings.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lit while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Submit a detailed report to the Architect / Owner of post start-up activity.

H. Tighten all panel Class I conductors from both circuit breakers and loads to torque ratings as marked on enclosure UL label.

I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed
4. Reports providing each device's settings.

3.4 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete and fully functional system.

B. The factory commissioning shall include the following services.
1. Programming of all button stations,
2. Configuration of all occupancy sensors and photocells.
3. Verification of a complete and working system.

C. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

D. The electrical contractor shall request factory commissioning by submitting a startup request form at least (4) weeks before startup is required.

E. Electrical contractor must schedule the lighting control factory start-up to begin at least 60 days prior to substantial completion deadline.

F. Lighting control technician shall issue daily reports notifying of the project status, open issues, challenges, etc. at the end of each day he/ she is onsite commissioning the system. Reports shall be sent directly to EC, GC and Engineer.

G. At the completion of the first visit of the lighting control technician, all parties shall meet onsite to walk the project and evaluate any open issues. At this meeting the schedule for owner training shall be determined.

H. The electrical contractor shall provide at least (1) journeyman electrician, familiar with the installation of the system, dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.

I. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

J. Re-commissioning – After 90 days from occupancy the factory authorized representative and electrical contractor shall re-calibrate all sensor time delays and sensitivities to meet the Owner’s Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity

K. Owner operation memo- Lighting control manufacturer shall prepare an operational memo for owner to distribute informing building occupants of the operation of their lighting control system. Memo shall explain the following but not limited to: auto on/ vs manual on, occupancy sensors, daylight harvesting, plug load control, after hours time delays.

END OF SECTION 26 09 43

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

A. New: Provide all new equipment.

B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.

C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.

D. NEC: Equipment and installation shall comply with the National Electrical Code.

E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.

F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

A. Provide complete product data for each equipment type. Provide electric service studies when required.

B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings. Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.

C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.

D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.

E. Provide Arc Flash Hazard Analysis per Specification 26 05 73.19 Arch-Flash Hazard Analysis

F. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 OWNER'S INSTRUCTION

A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. Instruction shall include a functional training session on digital metering system operation and system test procedures. Demonstrate the transfer of metered values to the Building Automation System. Review manufacturer’s

recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
   1. Schneider Electric
   2. Siemens
   3. ABB
   4. Eaton

2.2 ARC FAULT REDUCTION

A. The following static or adjustable circuit breakers shall be provided with Reduced energy Let-Through (RELT) switch with local status indicator in accordance with the NEC requirements
   1. Circuit breakers rated 1,200 amperes or larger
   2. Circuit breakers identified in an Arc-flash Hazard Analysis Study, as specified under Section 26 05 73.19

B. Documentation identifying the location of the circuit breaker and the arc-energy reduction method shall be provided.

2.3 ENCLOSED SWITCHES

A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.

B. Switch Interior:
   1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
   2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
   3. All current carrying parts shall be plated to resist corrosion.
   4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
   5. Switches shall have provisions for a field installable electrical interlock.

C. Switch Mechanism:
   1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
   2. The operating handle shall be an integral part of the box, not the cover.
   3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
   4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
   5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

D. Switch Enclosures:
1. Switch covers shall be attached with welded pin-type hinges.
2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
3. The enclosure shall have ON and OFF markings stamped into the cover.
4. The operating handle shall be provided with a dual colored, red/black position indication,
5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
6. Tangential knockouts shall be provided to facilitate ease of conduit entry.

E. Switch Ratings:
1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
3. Non-Fusible: 10,000 rms symmetrical amps.

F. Fuse Clips: NEMA FU 1, Class J fuses.

2.4 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.

B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.

C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.

D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 3R.

E. Nameplate: Provide a nameplate showing load served.

2.5 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

A. Square D - Class 2510 Type F.
1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.6 MAGNETIC MOTOR CONTROLLERS

A. Square D - Class 8536 Type S.
1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
3. Coil: Be of encapsulated type.
4. Poles: as indicated.

5. Size: as indicated.
6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
7. Wiring: Straight-through wiring with all terminals clearly marked.
8. Overload Relay: NEMA ICS.
   a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
   b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
   c. Reset: Unit shall include both manual reset and remote reset using an external module.
   d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
11. Provide red LED running pilot light and H-O-A switch.

2.7 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

A. Square D - Class 8810 Type S.
   1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
   2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
   3. Coil: Be of encapsulated type.
   4. Poles: as indicated.
   5. Size: as indicated.
   6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
   7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
   8. Wiring: Straight-through wiring with all terminals clearly marked.
   9. Overload Relay: NEMA ICS.
      a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
      b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
      c. Reset: Unit shall include both manual reset and remote reset using an external module.
      d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
   10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.

11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.8 COMBINATION DISCONNECT / MOTOR STARTERS

A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).
1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.9 FUSES (600 VOLTS AND BELOW)

A. Manufacturers:
1. Bussmann.
2. Little Fuse
3. Ferraz Shawmut

B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.

C. Voltage: Rating suitable for circuit phase-to-phase voltage.

D. Class J (Time Delay) Fuses
1. Dimensions and Performance: NEMA FU 1.
2. Voltage: Rating suitable for circuit phase-to-phase voltage.
3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.

E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.10 TWO-WINDING TRANSFORMERS

A. Product Description: Provide transformers in accordance with the following standards, where applicable:
1. Underwriter’s Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
2. Underwriter’s Laboratory 506, Standard for Safety for Specialty Transformers
3. NEMA ST 20, Dry Type Transformers for General Applications
4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18,

2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.

B. Ratings as indicated on Drawing.

C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.

D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.

E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.

F. Winding Taps:
1. 2 at 2.5 percent above rated voltage.
2. 4 at 2.5 percent below rated voltage.

G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.

H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.

I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

J. Mounting:
1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for floor mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

K. Coil Conductors: Continuous copper windings with terminations brazed or welded.

L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.

M. Isolate core and coil from enclosure using vibration-absorbing mounts.

N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.11 TRANSFORMERS FOR NONLINEAR LOADS

A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.

B. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.

F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy

current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.

G. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.

H. Isolate core and coil from enclosure using vibration-absorbing mounts.

I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.12 DISTRIBUTION PANELBOARDS

A. Manufacturers: Square D I- Line, Class 2110.

B. Product Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

D. Continuous current rating shall be sufficient to protect wiring and equipment served.
1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
2. Panels greater than 400A: 65,000 amperes rms symmetrical.

E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Main Circuit Breaker:
1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.

G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

2.13 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;

D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

I. Provide ground-fault circuit breaker for each heat trace branch circuit.

J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

2.14 MOTOR CONTROL CENTERS

A. General:
1. Provide totally enclosed, freestanding, motor control center with sections joined together to form one rigid unit. Motor control centers shall be similar to Square D Model 6 Class 8998.
2. NEMA Class: I.
3. NEMA Wiring Class: Type B.
4. Standard: NEMA Standard ICS 2 Industrial Control and Systems.
5. Underwriters Laboratories: UL 845 "Electric Motor Control Centers". Each vertical section shall be UL listed. Each motor control unit shall be UL listed.

B. Installation: Freestanding on a four (4) inch concrete pad. Both the entire enclosure to the pad.

C. Structure:
1. Fabricated of code gage steel with steel doors formed into standardized units. Each vertical section shall have an independent isolated vertical wiring trough with full height hinged door. Back to back mounted devices in the same vertical bus module are unacceptable.
2. Structures shall be totally enclosed, dead front, freestanding assemblies.
3. Structure shall be NEMA type 1 gasketed general purpose.
4. Motor control center structures shall have continuous removable base channels. The top plate(s) shall be removable to facilitate cutting of conduit entry openings.
5. All steel parts shall be provided with a UL listed acrylic baked enamel or powder coat paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
6. Structures shall contain a minimum 12 inch high horizontal wireway at the top of each section and a minimum six (6) inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center to allow room for power and control cable to connect between units in different sections.
7. A vertical wireway shall be provided in each motor control center section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireways. The vertical wireway shall be barriered from control units and have a separate hinged door.
8. Unused spaces and spares shall have hinged doors.

D. Bussing:

1. Provide complete horizontal and vertical bussing with wiring spaces at top, bottom, and vertically in each section. All bussing shall be silver plated 98 percent conductivity copper.
2. The main horizontal bus shall be fully rated and shall extend the full length of the motor control center. Include provisions for splicing additional sections onto either end of the motor control center.
3. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated no less than 125 percent of motor FLA in that section. Vertical bus shall extend full height of section, including all spare and space units. For purposes of calculating vertical bus ampacity, each space shall count no less than FLA of smallest motor served in that section.
4. A tin or silver plated copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be rated no less than 1/3 of horizontal main bus amps. Provide a vertical ground bus in each section used for plug-in units. Plug-in units shall have a ground stab arranged for first-make, last-break relative to the power bus stabs.
5. Motor control centers shall be separated into shipping blocks of no more than three vertical sections each.
6. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be isolated from the horizontal wireways and starters. Barriers shall be removable to allow access to the bus and connections for maintenance.
7. The vertical bus shall be housed in modular glass filled polyester supports that provide bus insulation. These supports shall have openings every three (3) inches for unit stab-on connections. Each opening shall be provided with a closing plug to close off the stab opening.

E. Terminations:
1. Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
2. All starter units shall be provided with unit control terminal blocks.

3. Terminal blocks shall be the pull-apart type rated at 20 amps. The stationary portion shall be used for field connections and will remain attached to the cubicle when the unit is removed. The removable portion of the terminal blocks shall be used for the unit wiring factory connections.

F. Protective Devices:
1. Class J Fusible Switch-Starter Units: Plug in type with silver plated pressure type line disconnecting stabs of high strength copper alloy. Each unit shall be totally enclosed and effectively barriered, and shall be so designed that it can be located anywhere within the structure using the same overload heaters for the same load. Fusible switches shall be manually operated quick make, quick break, horsepower rated. Coordinate fuses and overload heaters for proper acceleration time of motors provided. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by 1 to 3 padlocks. Provide Class J fuse clips. Provide magnetic starter components as specified in Article MOTOR CONTROLLERS. Provide fuses field-installed in accordance with Article FUSES.
2. Circuit Breakers (with no motor controller): Molded case, bolted type, quick make, quick break, trip free, common thermal magnetic trips. Operating handle shall clearly indicate ON or OFF. Means shall be provided for locking each breaker in OFF position by one to three padlocks. Automatic tripping indicated by handle at center position.

3. Fused Switch (with no motor controller): Quick make, quick break, horsepower rated. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by one to three padlocks. Provide Class J Type fuse clips. Provide fuses in accordance to Article FUSES located in this section.
4. Starters: all starters for motor control center to be size 1 minimum or larger.

G. Short Circuit Current Ratings:
1. Protective devices, together with the bussing and bracing, shall safely and without failure withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage. Provide higher ratings when indicated on the Drawings.
2. Bus bracing shall be provided for the entire bus network to withstand the mechanical forces generated during the specified short circuit.
3. The main device serving the motor control center, every motor control unit and other overcurrent devices installed in the motor control center shall have an interrupt rating no less than the specified short circuit.
4. The entire motor control center shall be suitable for operation at the specified available fault current. The motor control center shall be labeled by the manufacturer to indicate the maximum available fault current rating, taking into account the structure, bussing, main feeder and all units and devices included in the motor control center. This fault current withstand rating shall be the basis for the UL Short-Circuit Current Rating.

H. Nameplate:
1. Identify each device with nameplate showing load served. Refer to "Labeling" in Section 16050.
2. Provide a master nameplate on face of units similar to following, with correct data shown:
Motor Control Center
480 Volts, 3 Phase, 3 Wire, 60 Hertz
Main Bus:____amps. braced for_____ amperes RMS Symmetrical
Date Installed:
3. Provide a nameplate for each vertical section marked with section characteristics and factory identification. This nameplate may be manufacturer's standard construction.
4. Provide UL listing marks on each section and unit in manufacturer's standard format.

I. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings including proof of any UL-listed series ratings (if series rating allowed by specification).
7. Motor Controller and Protective Device Ratings, including catalog pages for all current-limiting devices.
8. Identify NEMA Class of submitted mcc.
9. Identify NEMA Wiring Type of submitted mcc.
10. Single Phase Relay
11. Unit Elevation
12. Bussing Schematic, Sizes and statement of Conductor and Plating Material.
13. Original Manufacturer Brochure and Specifications

2.14 MAIN SWITCHBOARDS:

A. General: Provide universal building–type switchboards fabricated in accordance with NEMA Standard PB–2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.

B. Structure:
1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1–1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
2. When “SPACE” is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.

C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.

D. Instrumentation:
1. General: Monitor the incoming line with a Square D PM 5563 meter with BACnet IP communication port protocol.
Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).

E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 2000 amperes and shall be full height**. Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension**. Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full–size neutral rated at 100 percent of phase bus.

F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.

G. Short Circuit Ratings:
1. Switchboard assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to 65,000 (or 100,000) amps RMS symmetrical at nominal system voltage.

H. Provisions for Auto Power Factor Controller (APFC):
1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.
3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
4. Refer to Section 26 35 33 for additional requirements of auto pf controller.

I. Protective Devices:
1. Switchboard Main Breaker:
a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D NW (3000-4000), [RJ (1600-2500A) 65KA or RL (1600-2500A) 100KA] ampere frame size.
b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
c. Minimum interrupting rating of 65,000 (or 100,000) amperes rms symmetrical at 480/277 Volts.
d. Local trip indicators: overload, short circuit and ground fault.
e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
f. Adjustments:
1) The electronic trip unit shall have LSIG Trip functions.
2. Feeder Devices:
a. Breakers 700 Amps and Larger:
1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated 100% with electronic trip units, similar to Square D [NW (3000-4000A], [RJ (1600-2500A 65kaic 100%)], [RL (1600-2500A 100kaic 100%)], [PJ (700-1200A 65kaic 100%)], [PL (700-1200A 100kaic 100%)]
2) Interrupting rating shall be at least 65,000 (or 100,000) amperes rms symmetrical at 480/277 Volts.
3) The electronic trip unit shall have LSI trip functions.
4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.

b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
c. The breaker shall be UL Listed for continuous duty at 100% of the current rating

J. Transient Voltage Surge Suppressor (TVSS):
1. General: Provide a Square D Class 1310 240kA surge current rated mounted in the switchboard mounted above the main circuit breaker compartment.

K. Lightning and Overvoltage Surge Arrester:

1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.
2. Description: Device shall be a heavy duty, three–phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.

L. Identification:
1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard_____
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz
Main Bus:___amps. braced for___ RMS sym. amps.
Date Installed:

M. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings
5. Voltage Ratings
6. Short Circuit Ratings
7. Protective Device Ratings
8. Electronic metering system
9. Surge Arrester
10. Unit Elevation
11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials
12. Original Manufacturer Brochure and Specifications
13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.

N. Testing: Test all devices and systems to assure proper operation.

2.15 SERVICE ENTRANCE CABLE TAP BOX (CTB):

A. Cable Tap Box:
1. General: Provide weatherproof, freestanding phase collection and cable tap box. Fabricate in strict accordance with Electric Utility requirements. Line side connection from building pad-mounted transformer shall be through underground conduit and wire, load side connections to the building main switchboard(s) shall be weatherproof outdoor busway.
2. Structure: Formed up steel channels bolted together to form a rigid structure to which formed-up fronts, side sheets, and rear covers are bolted. Front and rear doors shall be hinged. Galvanized 1-1/2 inch x 4inches mounting channels on bottom, rear left, and right sides to close all side openings at the bottom. Interior framing shall be galvanized steel 1-5/8" rigid channel or approved equal system. Enclosure shall be tamper proof and outdoor weatherproof.

3. Installation: Freestanding and level on an outdoor concrete pad. Provide anchor bolts. Pad shall be outside all Electric Utility easements. Stub up conduits for Electric Utility service lateral and customer-side service entrance conduits. All underground conduit to/from CTB shall be concrete-encased.
4. Bussing: Insulated bussing, silver plated 98 percent conductivity copper. Bussing shall be sized in accordance with UL and NEMA Standards. In addition, size copper bus for not more than 1000 Amperes per cubic inch current density. Provide 3 phase, 4 wire, (100 percent neutral) bussing. Install with rigid supports to meet fault current rating.
5. Fault Current Rating: Bussing and bracing shall safely and without failure withstand short circuits on a system capable of delivering up to 100,000 amperes rms symmetrical at nominal system voltage. Install rope tie as required after cable installation to maintain bracing for short circuit current rating.

B. Electric Utility Requirements:
1. Prior to fabrication, submit three (3) prints of proposed cable tap box (CTB) to the representative designated by the Electric Utility. Submit prints only after shop drawings have been submitted and review cycle is complete with the Architect. Allow at least eight weeks time for review by Electric Utility prior to desired date of new service cut-in. Allow additional time for Architect/Engineer review prior to submittal to Electric Utility.
2. Cable tap box enclosure shall be tamper proof and weatherproof. Entire cabinet shall be tamper-resistant.
3. Form roof with cross-kink to force water to run off the cabinet.
4. Paint Finish Color: Match color of Electric Utility padmount transformer. Minimum finish shall be prime coat plus at least 6 mils of finish coat paint in two (2) applications.
5. Provide full-height doors on both utility side and customer side. Each door shall be hinged and have a vault-style handle with padlocking provisions. Electric Utility will install its padlock. Provide weatherproof padlock on customer door and give Owner ten (10) copies of key.
6. Fabricate CTB with two separate compartments; one side for Electric Utility connections and the opposite side for Customer connections. Compartments shall be separated with an insulating barrier. Size cabinet to maintain necessary wire bending radius in Electric Utility and Customer compartments.
7. All insulating barriers shall be one (1) inch black phenolic resin, NEMA Grade N-1 or XX, or phenolite (Grade GPO-3).
8. Each bus bar shall be copper, minimum 1/4 inch x 4 inches. Drill and tap for six (6) sets of 2-hole compression lugs per bus bar on Electric Utility side or other configuration stipulated by E.U. Lowest edge of all bus bars shall be 36 inches above top of concrete foundation. All bus bar dimensions, quantities, bracing and exact layout shall be per approved details from the Electric Utility for this specific job site. Parallel sufficient bus bars to achieve ampacity shown on Electrical Drawings for both Electric Utility and Customer side of CTB. Drill and tap for 2-hole NEMA D-tang compression lugs for termination of Customer cables.
9. Install CTB level and bolted to a concrete foundation. Locate outside work space clearance and easements associated with Electric Utility padmount transformer and primary ductbank.
10. Cable Termination: Terminate all cables with NEMA-pattern, two-hole, compression lugs.

C. Submittal to A/E: Include at least the following:
1. Manufacturer and Model Numbers
2. Dimensions: plan, elevations, bus bars.
3. Cable Termination Provisions
4. Current Rating

5. Voltage Rating
6. Short Circuit Withstand Rating
7. Bussing Sizes, Layout and Statement of Conductor and Plating Materials
8. Certify weatherproof cabinet construction. Certify paint finish type and thickness.
9. Coordination Drawing showing cable tap box, Electric Utility padmount transformer with required work space clearances, meter location, and underground conduit entrances.
10. After A/E shop drawing cycle is complete, submit three complete copies to Electric Utility.

2.16 SEQUENCING PANELBOARD FOR THEATER SOUND REINFORCEMENT SYSTEM:

A. Features:
1. Supply all ac circuits for audio/visual equipment in the high school theater A/V room from time sequence panelboard capable of being remote controlled from multiple locations.
2. 41 sequenced circuits per panelboard.
3. A means of visual operator feedback shall provide an indication of the progress of the power turn-on and turn-off sequence at each control point.
4. Sequencing shall have an adjustable time delay between the low level equipment circuits and the power amplifier circuits.
5. The sequencing system shall be capable of shedding the load within three (3) seconds after a power failuer and re-sequencing when power resumes without operator intervention.
6. Provide one LynTec Cat. No. SS-2 Sequencer Switch Set with every 41-circuit panelboard.
7. Provide one LynTec Cat. No. SS-2PL Remote Locking Switch Plate with every 41-circuit panelboard.
8. Provide for each sequencing panelboard a LynTec Model No. SLC 341-41 filled with MB-Motorized Breakers, 3 phase, 4 wire, 208Y/120 Volt 225 Amp Main Breaker panel or approved equal.
9. Acceptable Manufacturer: LynTec Inc., 8401 Melrose, Lenexa, KS 66214-1647; telephone 800-724-4047, fax 888-722-4157, www.lyntec.com or email info@lyntec.com .

B. Cabinet: Safety dead front type; box made of Code gage galvanized steel; minimum gutter space 4" on all sides but not less than NEC requirements; door with flush type latch. Enclosure shall conform to NEMA 1.

C. Circuit Breakers:
1. General: Provide a breaker for each audio branch circuit to protect wiring and equipment served.
2. Description: Each breaker shall have motor drive for individual breaker remote control. Breakers shall be quick make, quick break, trip free, thermal magnetic trip. Automatic trip shall be indicated by the handle at the midpoint position. Multiple pole breakers shall have common trip.

D. Short Circuit Ratings: 120/208 volt systems 10,000 amperes RMS symmetrical.

E. Phase, Neutral and Ground Bussing: Silver or tin plated 98 percent conductivity copper sized in accordance with NEMA Temperature Rise Standards and installed completely throughout panel for installation of future breakers where schedule shows space only. Provide an equipment grounding bus bonded to the panel cabinet. Ground bus shall have a terminal screw for every breaker in the panel.

F. Termination: Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.

G. Surge Protective Device: Install a Transient Voltage Surge Suppressor (TVSS) on the sequencing panelboard. TVSS shall be Current Technology TransGuard TG60 Series or Liebert Interceptor Model 111 Series.

H. Nameplate: Nameplate on front face showing panel name and voltage. Coordinate to give same name as shown on Drawings.

I. Directory: Complete at end of job, typewritten, contained in frame on the inside of the panel door. Frame shall have a protective plastic shield. Label every breaker to match directory.

2.17 ELEVATOR SHUNT TRIP DISCONNECT

A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.

B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.

C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

2.18 ROOF MOUNTED PEDESTALS

A. Roof Utility Pedestal with 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products utility roof pedestal #MPX-20G: 36/12.

B. Roof Pedestal with Non-Fused Disconnect Switch and 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products roof pedestal #MDP – (XX). See plans for disconnect sizes.

PART 3 - EXECUTION

3.1 MOUNTING:

A. General: All equipment shall be securely fastened in place.

B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.

C. Concrete Pads:
1. Provide concrete in accordance with the Division of the Specifications for that product.
2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.

D. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.

E. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

A. General:
1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.

B. Approved Conditions for Equipment Storage:
1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
   a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
   b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
   c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
   d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.

C. Transformer
1. Indoor storage shall be provided for all transformers.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 TRANSFORMER VIBRATION ISOLATION:

A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.

B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.

C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.

D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

3.5 TRANSFORMER VENTILATION:

A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

3.6 POWER SHUT OFF UNDER KITCHEN HOODS:

A. NFPA:
1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.

B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. Coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.

C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system. Refer to Section 26 05 53 for additional fire alarm system requirements.

3.7 LABELING:

A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.

B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.

C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 WALL SWITCHES

A. Single Pole Switch, Toggle Style:
   1. Leviton 1221 Series, 20A, 120/277V.

B. Double Pole Switch, Toggle Style:
   1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.

C. Three-way Switch, Toggle Style:
   1. Leviton 1223 Series, 20A, 120/277V.

D. Four-way Switch, Toggle Style:
   1. Leviton 1224 Series, 20A, 120/277V.

E. Indicator Switch, Toggle Style:

1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.

F. Locator Switch, Toggle Style:
1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.

G. Digital Time Switch:
1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.

H. Key lock switches:
1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
2. 20 Amp rated.
3. 120/277 Volt ac rated.
4. Key-lock mechanism can only be turned ON or OFF with key.
5. Single pole: Leviton 1221-2KL or approved equal.
6. 3-Way: Leviton 1223-2kl or approved equal.
7. 4-Way: Leviton 1224-2kl or approved equal.
8. Provide 302 stainless steel wall plate for each switch.
9. Provide 2 keys on ring for each switch.
10. Include a brass tag on every key switch ring. Engrave tag; Example: “Hall East Lights”.
11. Key all switches alike to match the owners standard key. Coordinate with school District for key match.

I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.

B. Leviton MMS Series.

2.4 WALL DIMMERS

A. Manufacturers:
1. Lutron Nova "T" Series.

B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.

C. Body and Handle: Linear slide handle, color as selected by Architect.

D. Voltage: 120 volts.

2.5 RECEPTACLES

A. Single Convenience Receptacle:
1. Leviton 5362A Series, 20A/125V.

B. Duplex Convenience Receptacle:

1. Leviton 5362 Series, 20A/125V, respectively.

C. GFCI Receptacle:
1. Leviton 7899 Series, 20A/125V.
2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).

D. Isolated Ground Duplex Receptacle:
1. Leviton 5362-IG, 20A/125V.

E. Duplex Tamper Resistant Receptacle/ USB Charger
1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.

F. Provide 20 amp receptacle for single-receptacle branch circuits.

G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.

H. Color: As selected by Architect.

2.6 WALL PLATES

A. Type 302 Stainless Steel with matching mounting screws.

2.7 DEVICE COVERPLATE LABELING

A. Provide machine-printed adhesive labels on receptacle and switch coverplates.

B. Labels shall be:
1. Printed using thermal transfer labeler (P-TOUCH or approved equivalent).
2. Laminated type with clear protective overlay.
3. Black lettering on white background with 1/4” high lettering unless noted otherwise. Provide uniform text size and format throughout project.
4. White lettering on red background for devices served by emergency power.
5. Label size shall not obstruct device operation or coverplate fasteners.

C. Label material shall be durable and suitable for the environment installed, including resistance to moisture, abrasion, and cleaning solutions

D. Handwritten or not-laminated labels are not acceptable.

E. Provide coverplate labels for the following:
1. All receptacles requiring panelboard and circuit identification including receptacles serving dedicated equipment or special purpose loads.
2. All switches including general room lighting.
3. Devices where function is not readily apparent or as directed by owner.

F. Install labels
1. Straight, level and centered on coverplate.
2. With consistent location and orientation throughout project.
3. After final cleaning of coverplates to ensure proper adhesion.

G. Label content shall include:

1. Panelboard designation and circuit number (E.G. “L1-12”).

2.8 MANUFACTURERS

A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
   1. Leviton
   2. Pass & Seymour
   3. Hubbell / Bryant
   4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.

B. Maintain access to existing boxes and wiring connections remaining active and requiring access.

C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

A. Route raceway and cable to meet Project conditions.

B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.

D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.

E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.

B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.

C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPDs) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Section 16400 – Surge Protection Devices, individually mounted and switchboard mounted. Switchboards: Surge Protection Device integrated in switchboards.

1.3 REFERENCES

A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,

B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,

C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

D. National Electrical Code: Article 285

E. UL 1283 - Electromagnetic Interference Filters

F. UL 1449, Third Edition, effective September 29, 2009 – Surge Protection Devices

1.4 SUBMITTALS

A. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.

B. Submittals shall include UL 1449 4th Edition Listing documentation verifiable by visiting www.UL.com, clicking “Certifications” link, searching using UL Category Code: VZCA and VZCA2:
   1. Short Circuit Current Rating (SCCR)
   2. Voltage Protection Ratings (VPRs) for all modes
   3. Maximum Continuous Operating Voltage rating (MCOV)
   4. I-nominal rating (I-n)
   5. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications.

C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.

D. Minimum of ten (10) year warranty Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 QUALITY ASSURANCE

A. List individual units under UL 1449 (Forth Addition) and UL 1283.

B. Single manufacturer: All equipment of each type shall be the product of one manufacturer.

C. SPD shall comply with NEC Article 285 and shall be permanently marked with the short-circuit current rating of the device.

D. Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.

E. Manufacturer shall be ISO 9001 or 9002 certified.

F. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

G. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept equipment on site in factory packaging. Inspect for damage.

B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.

C. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

A. Manufacturers:
1. Current Technology
2. Southern Tier Technology
3. Siemens
4. Square D
5. GE

B. Product Description: Surge protection devices for protection of AC electrical circuits.

C. Unit Operating Voltage: As indicated on Drawings.

D. Construction:
1. Finish: Factory finish of baked enamel.

2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with computer matched +/1% MOV for equal load share.
3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
   a. Continuous monitoring of fusing system.
   b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
   c. Monitor for overheating in each mode due to thermal runaway.
   d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
5. Labeling: Permanently affix UL 1449 (Forth Addition) suppression voltage ratings and CSA to unit.

E. Types:
1. Switchboards; locate as integral part of switchboard, coordinate mounting with switchboard manufacturer.
2. Panelboards; locate as stand-alone. Component in housing adjacent to protected panelboard. Install less than 10ft from the panel with minimum bends in the wire.

F. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).

G. Switchboards:
1. The SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
2. SPD shall meet or exceed the following criteria:
   a. Maximum 7-Mode surge current capability shall be 300kA per phase.
   b. UL 1449 – 4th Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	L-L	MCOV
208Y/120	700V	700V	700V	1200V	150V
480Y/277	1200V	1200V	1200V	2000V	320V

3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/347	15%	320V

4. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.
5. Suppression components shall have redundant protection designed to share surge currents.

6. SPD shall include a serviceable, replaceable module.
7. SPD shall be equipped with the following diagnostics:
   a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
   b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
   c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
   d. Surge Counter

   No other test equipment shall be required for SPD monitoring or testing before or after installation.
8. SPD shall have a response time no greater than 1/2 nanosecond.
9. SPD shall have a 10 year warranty.

H. Distribution and Lighting Panelboards:
1. Listing requirements: SPD shall bear the UL Mark and shall be Listed to most recent editions of UL/ANSI 1449 and UL 1283. “Manufactured in accordance with” is not equivalent to UL listing and does not meet the intent of this specification.
2. Listing requirements: SPD and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved. (To access UL Category Code click on Certifications in the left menu bar of UL’s home page. Type “VZCA” into the Category Code search box and click Search.)
3. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
4. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
5. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
6. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems
7. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD’s.
8. SPD shall meet or exceed the following criteria:
9. Minimum surge current capability (single pulse rated) per phase shall be:
   a. Distribution applications:
      1) Southern Tier Technologies T45XXXX050AWAJ2C with Maximum surge current capability of 100kA per phase

10. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277V	20%	320V

11. SPD shall include a serviceable, replaceable module (excluding Distribution). (Deletable note: Delete or adjust as appropriate.)
12. Service Entrance ul Type 2 devices SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
13. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.
14. SPDs shall be equipped with the following diagnostics:
    a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
    b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
    c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
    d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting area is ready for equipment.

B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

A. Install in accordance with IEEE 1100.

B. Install service entrance suppressors in switchboard.

C. Install suppressors for panelboards adjacent to panel.

D. Install surge counter in face of switchboard.

E. Include surge counter for stand-alone SPD.

F. Install with maximum conductor length of 24 inches. Install suppressor with internal fusing.

G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD.

END OF SECTION 26 43 00

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaries complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

A. Product Data: Submit dimensions, ratings, and performance data.

B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.

C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Provide luminaires listed by U.L.
2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.

B. Certification: Certify that fixture submittals have trim compatible with ceilings being installed.

C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.

B. Provide two (2) spare drivers for each fixture type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Acceptable Manufacturer Representatives:
1. CW Lighting
2. PSA Lighting
3. Lesco

B. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.

C. All luminaires shall be new and of specification grade.

D. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.

E. Wire guard at fixtures in mechanical, electrical, and high abuse areas.

F. Approved equal: Contractor may submit luminaires from other manufacturers. Contractor shall provide a full set of submittals per paragraph 1.2 of this specification section for Engineer and Architects approval. Contractor must have approved submittals stamped and dated from the Engineer and Architect minimum 10 days prior to bid.

2.2 LED LUMINAIRES

A. Quality Assurance
1. DOE Lighting Facts certified.

B. LED Specifications
1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
2. CRI:>80 minimum (general); >90 healthcare and retail.
3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
5. Outdoor luminaires to be rated to a minimum of 40^0 C.

C. Lumen Maintenance
1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25^0 C, outdoors at an ambient temperature of 40^0 C.

D. Thermal Testing
1. ISTM testing in accordance with UL 1598-2008.

E. Driver
1. 0-10V enabled.
2. Output Class 2 rated.
3. Dimming range: 5-100%.
4. Constant current.
5. THD @ max load: <20%.
6. Power factor: >0.95
7. Environment protection rating: UL Damp and dry.

8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
9. ROHS Compliant

F. Fixture photometry
1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
2. System flux measured in delivered lumens.

G. Warranty
1. 5 year total system warranty.

2.3 EMERGENCY BATTERY PACKS

A. Provide emergency battery pack for fixtures designated to have emergency battery back-up.

B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.

C. Provide unswitched alternating current power source per manufacturer's instructions.

D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.

E. For fixtures designated to have emergency battery pack and on a contactor controlled circuit, provide an unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.

F. Battery pack shall provide 1100 lumen output for 90 minutes per 2'x4' light fixture.

G. Provide integral battery pack for all exit signs where emergency generator power is not available. Battery pack shall provide minimum of 90 minutes output.

2.4 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

A. Provide a UL 1008 automatic transfer switch for each switch group containing lighting fixtures shown to be on emergency.

2.5 DOWNLIGHT FIXTURES

A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.6 EXIT SIGNS

A. Exit signs shall meet visibility requirements and be listed per UL 924 " Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.

B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.

C. Product Description:
1. LED Exit Sign:
a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.

D. Housing: Diecast aluminum with stencil face and matte white paint finish.

E. Input Voltage: 120/277 volt, dual input voltage.

F. EPA Energy Star Label.

G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.7 OUTDOOR LUMINAIRE POLE ASSEMBLIES

A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.

B. 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.

C. Minimum Wind Speed: 120 miles per hour or local wind ratings, whichever is higher.

D. Metal poles shall comply with NEC 410-15(b).

E. Pole Material: Steel.

F. Pole Shape: Round tapered.

G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.

H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.

B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.

C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

A. General: All luminaires shall have proper supports.

B. Install suspended luminaires using pendants supported from swivel hangers.

C. Locate recessed ceiling luminaires as indicated on Drawings.

D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

E. Chain Hung: Unless otherwise indicated all LED fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.

F. Suspended Ceilings:
1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
3. Luminaires shall be centered in ceiling tile.
4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.

G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

CLEANING

A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.

B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.6 OUTDOOR LUMINAIRE POLES

A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.

B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole to be refinished at pole factory.

C. Installation:
1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
4. Minimum wire size for circuit tap inside pole shall be AWG #12.
5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.

D. Fusing:
1. Install fuse holder and fuses as noted in pole base detail on Drawings.
2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.

E. Grounding:
1. Install #8 ground wire bonded to pole with lug as noted in pole base detail on drawings.
2. Provide a 3/4”X10’ copperweld ground rod driven into earth with the ground wire bonded by cadweld process as noted in pole base detail on drawings.

END OF SECTION 26 50 00

SECTION 26 56 68 – INTERIOR ATHLETIC LIGHTING

Lighting System with LED Light Source

PART 1 – GENERAL

1.1 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.

B. The purpose of these specifications is to define the lighting system performance and design standards for Tomball High School using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.

C. The sports lighting will be for the following venues:

1. Indoor Arena

D. The primary goals of this sports lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 10 years.
2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators, and neighbors.
3. Cost of Ownership: In order to reduce the operating budget, the preferred lighting system shall be energy-efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
4. All lighting designs shall comply with UIL Standards.
5. Control and Monitoring – To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 10-year life cycle. All communication and monitoring costs for a 10-year period shall be included in the bid.

1.2 ONFIELD LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting manufacturers will provide a guarantee that light levels will be sustained over the life of the warranty period. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below.

Manufacturers will provide lumen maintenance data of the LED luminaires used per TM-21-11 and will Incorporate the lumen maintenance projections Into the lighting designs to ensure target light levels are achieved throughout the guaranteed period of the system. Per IES guidelines, lumen maintenance hours should be reported based on the 6x multiplier of testing hours.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Indoor Arena	100 foot-candles	2.0:1.0	54	30’ x 30’

B. Color Temperature: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

C. Playability: Lighting design and luminaire selection should be optimized for playability by reducing glare on field and providing sufficient uplight.

1. Aiming Angles: To reduce glare, luminaire aiming should ensure the top of the luminaire field angle (based on sample photometric reports) is a minimum of 10 degrees below horizontal.
2. Glare Control Technology – Luminaires selected should have glare control technology including, but not limited to: external visors, internal shields and louvres. No symmetrical beam patterns are acceptable.
3. Mounting Heights: To ensure proper aiming angles, minimum mountings heights shall be as described below. Higher mounting heights may be necessary for luminaires with lesser glare control to meet field angle requirements of section 1.2.C.1.

# of Fixture Mounts	Mount Designation	Mounting Height
12	C13 – C24	16’
36	B6, B15, B21 – B36	30’
44	A21 – A40	44’

1.4 Cost of Ownership

A. Manufacturer shall submit a 10-year Cost of Ownership summary that includes energy consumption, anticipated maintenance costs, and control costs. All costs associated with faulty luminaire replacement - equipment rentals, removal and installation labor, and shipping - are to be included in the maintenance costs.

PART 2 – PRODUCT

2.2 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

C. System Description: Indoor Lighting system shall consist of the following:

1. Mounting Requirements: Indoor luminaires will need to be a straight row along each side of the field. There cannot be any luminaires mounted down below. The contractor will be responsible for confirming the mounting details on plan sheets or from the owner.
2. Custom Mounting Hardware: Manufacturer shall provide all design work, brackets, and hardware for mounting the lighting system to the facilities structure to ensure a clean appearance and ease of installation.
3. Obstruction Compensation: To achieve the illumination and uniformity design levels required, the manufacturers design calculations and fixture aiming positions must take into account for

any obstructions in the ceiling. For example, speakers, video boards and building materials. Please see site plans or work with the owner to locate any of these items.

4. Manufacturer will supply all drivers and supporting electrical equipment.

   a. Remote drivers and supporting electrical equipment are to be located in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed. The location of the electrical enclosure cabinets will need to verified via the Plan sheets or the owner.

4. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.

5. Control cabinet to provide remote on-off control, monitoring features of the lighting system. See Section 2.3 for further details.

8. Contactor cabinet to provide on-off control.

D. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:
   1. Electric power: Per Plans.
   2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 65.06 kW.

2.3 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Contactor control of lights: To minimize wear on drivers and other electrical components and prevent lights from turning on due to communication loss, circuits must be controlled via contactor switching, not dimming driver output to zero.

D. Dimming: System shall provide 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, fax, email).

E. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

   The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

   Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

F. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

G. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility
2. Report hours saved by using early off and push buttons by users.

H. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 10 years.

I. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of wireless communication.

PART 3 – EXECUTION

3.1 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 8-10 weeks from receipt of approved submittals and receipt of complete order information.

3.2 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-22.

B. Field Light Level and offsite Glare Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 10 years. These levels will be specifically stated as “guaranteed” on the illumination summary provided by the manufacturer.

2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.

3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, uplight for aerial visibility are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

A. 10-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 10 years from the date of shipment. Warranty shall guarantee specified light levels. The manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 10 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

PART 4 – DESIGN APPROVAL

4.0 PRE-BID SUBMITTAL REQUIREMENTS (Non-Musco)

A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.0.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.

B. Approved Product: Musco's SportsCluster System with TLC for LED™ is the approved product. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.

C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.

D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. ***Submit checklist below with submittal.***

Yes/ No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.

	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years' experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period. Glare values in candela must be guaranteed to not be exceeded.
	G	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system and entertainment packages. They will also provide ten (10) references of customers currently using proposed system in the state of Texas.
	H	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Texas.
	I	Electrical Distribution Plans	Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Texas.
	J	Project References	Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Texas. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	K	Product Information	Complete bill of material and current brochures/cut sheets for all products being provided.
	L	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	M	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	N	Cost of Ownership	Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 10 Years.

The information supplied herein shall be used for the purpose of complying with the specifications for Tomball High School. By signing below, I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer: _____ **Signature:** _____

Contact Name: _____ **Date:** _____/_____/_____

Contractor: _____ **Signature:** _____

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 – GENERAL

1.01 RELATED WORK

A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.02 SCOPE OF WORK

A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.

C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.

D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.03 DRAWINGS AND SPECIFICATIONS

A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.

C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.

D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.04 CODES AND STANDARDS

A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.

B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.

C. ANSI/TIA:
1. ANSI/TIA-526-7A:2015 (R2022) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
5. ANSI/TIA-568.0-E (2020) Generic B (supersedes TIA-568-C.0 and TIA-568-C-1)
6. ANSI/TIA-568.1- E (2020) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)
7. ANSI/TIA-568.2-E (October 2024) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
8. ANSI/TIA-568.3-E (September 2022) Optical Fiber Cabling Components Standard
9. ANSI/TIA-568.4-E (July 2022) Broadband Coaxial Cabling Components Standard
10. ANSI/TIA-569-E Addendum 1 (2022) Telecommunications Pathways and Spaces
11. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding, with Addenda 1 & 2.
12. ANSI/TIA-570-E (May 2024) Residential Telecommunications Infrastructure Standard
13. ANSI/TIA-606-D (October 2021) Administration Standard for Telecommunications Infrastructure
14. ANSI/TIA-607-E (May 2024) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
15. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
16. ANSI/TIA-862-D (June 2022) Structured Cabling Infrastructure Standard for Intelligent Building Systems
17. ANSI/TIA-942-C (May 2024) Telecommunications Infrastructure Standard for Data Centers
18. ANSI/TIA-1005-A (March 2020) Telecommunications Infrastructure Standard for Industrial Premises
19. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
20. ANSI/TIA-1183-B (February 2023) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
21. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz – Incorporated into TIA-1183-B
22. TIA-1152-A (June 2025) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
23. TIA-1179-B (June 2023) Healthcare Facility Telecommunications Infrastructure

Standard

24. ANSI/TIA-4966-A (February 2022) Telecommunications Infrastructure Standard for Educational Facilities. Addendum: TIA-4966-A-1, (March 2023), adds support for single-pair cabling
25. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
26. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
27. TIA-604-18-A (April 2024) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
28. TIA-604-5-F (March 2019) FOCIS 5 Fiber Optic Connector Intermateability Standard-Type MPO
29. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
30. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
31. TSB-184-A (March 2017) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
32. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
33. TSB-190-A (December 2023) Guidelines on Shared Pathways and Shared Sheaths
34. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
35. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
36. TIA-492AAAE (June 2016) Detail Specification for 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
37. TIA-492AAAB-A (November 2009) Detail specification for 50-µm core diameter/125-µm cladding diameter class Ia graded-index multimode optical fibers
38. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
39. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

D. ISO/IEC:

1. ISO/IEC TR 11801-9911:2024 – Guidelines for balanced single-pair applications within 4-pair cabling
2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
3. ISO/IEC 11801-5:2017 – Generic cabling for data centers
4. ISO/IEC 11801 series, including: 11801-1:2017 (General) 11801-2:2017 (Office premises)
5. ISO/IEC 11801-4:2017 – Generic cabling for homes
6. ISO/IEC 11801-3:2017 – Generic cabling for industrial premises
7. ISO/IEC 14763-2:2019 – Planning and installation
8. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
9. ISO/IEC 14763-3:2024 – Testing of optical fiber cabling
10. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
11. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
12. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment

E. BICSI – Building Industry Consultative Services International – Published Standards
1. ANSI/BICSI 001-2017 (R22) – ICT Systems Design for Educational Institutions
2. ANSI/BICSI 002-2024 – Data Center Design and Implementation Best Practices
3. ANSI/BICSI 003-2024 – BIM Practices for ICT Systems
4. ANSI/BICSI 004-2018 – ICT Design for Healthcare Facilities
5. ANSI/BICSI 007-2020 – ICT Design for Intelligent Buildings
6. ANSI/BICSI 006-2020 – DAS Design and Implementation Best Practices
7. ANSI/BICSI N1-2019 – ICT Installation Practices
8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
9. BICSI – Building Industry Consultative Services International – Manuals
10. Telecommunications Distribution Methods Manual, TDMM 15th Edition (2024)
11. Information Transport Systems Installation Methods Manual, ITSIMM 8th Edition (2022)
12. Outside Plant Design Reference Manual, OSPDRM 6th Edition
13. BICSI's ICT Terminology Handbook, Version 1.0
14. Telecommunications Project Management Manual, TPMRM 2nd Edition
15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
16. BICSI's Special ICT Design Considerations, Version 1.0
17. Essentials of Bonding and Grounding, Version 1.0

F. National Electric Codes
1. National Electrical Safety Code IEEE C2-2023 (NESC 2023 Edition)
2. NFPA 70-2023 (NEC 2023 Edition)
3. ANSI/ IEEE C2-2023, National Electrical Safety Code®
4. National Electrical Code (NEC) (NFPA 70-2023)
5. NFPA 72 National Fire Alarm and Signaling Code, NFPA 72-2025 Edition

G. ASHRAE
1. ANSI/ASHRAE Standard 90.4-2022, Energy Standard for Data Centers and Telecommunications Buildings

H. OSHA Standards and Regulations – all applicable

I. Local Codes and Standards – all applicable

J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.

L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor’s expense.

M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.05 EXISTING UTILITIES

A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.06 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.

D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.

B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.

C. If no manufacturer’s name is mentioned, the Contractor shall provide equipment and material

which meet the specifications.

D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.

B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.

C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.

B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor_____

Signed_____

Position_____

Date_____

*Refer to exception requirements herein.

D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.

2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.

3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.

4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the Engineer’s filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed index sheets also for the Engineer’s filing convenience.

F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.

G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.

H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.

I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as required.

3.05 CUTTING AND PATCHING

A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.

B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by the Contractor.

C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley

adjacent to the site.

B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.

B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered in place or an approved mastic sealer.

C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.

B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.

C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

A. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping other trades.

3.11 RECORD DRAWINGS

A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and

dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.

B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.

C. The manual shall include the following information
1. Manufacturer's installation instructions.
2. Manufacturer's local representative and/or distributor's name and address.
3. Manufacturer's operating and maintenance instructions.
4. Manufacturer's internal wiring diagrams.
5. Contractor's installation wiring diagrams.
6. Replacement part number listings and descriptions.
7. Framed operating instructions, when required, in individual Specification sections.
8. Warranties and guarantees.
9. Provide an approved submittal at the front of each section.

D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.

E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
1. Each section in the manual shall identify the grouping of all literature required for the system or equipment included.
2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.

2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.

4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.

2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.

3. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work ad in accordance with standard practice of the trades involved.

4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner.

All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION

SECTION 27 10 00 – CATEGORY 6 STRUCTURED CABLING SYSTEM (SCS)

This specification section is provided as part of the early equipment procurement package and outlines the manufacturers and model numbers of the equipment to be purchased. Reference the drawings and equipment schedules for actual equipment identified as being part of the early procurement package. All other references to installation and products will be part of the base bid construction package issued at a later date. Several sections within this specification have been highlighted to help identify equipment that is expected to be part of the early equipment procurement package.

Complete equipment submittals are due at the time of pricing submission for the early equipment package. Any pricing submitted without a submittal package will not be accepted. All submittals shall contain line by line specification compliance to indicate proposer is complying with equipment listed in this specification. Any deviations from the specification should be highlighted and identified and reason for deviation. Any incomplete submittals will not be accepted.

Reference the front-end documents for information related to equipment delivery dates, equipment storage requirements, warranty and process for unloading equipmentP to owner designated location.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. 26 05 00 – Grounding and Bonding
B. 26 05 29 – Electrical Hangers and Supports
C. 26 05 33 – Raceway and Boxes

1.3 DESCRIPTION

A. Summary of Work:
   1. Provide a complete and tested Category 6 cable distribution system for data interconnections (Local Area Network). The data distribution system shall include fully terminated unshielded twisted pair cables, raceways, conduit, UTP termination devices, data communications outlets, patch panels, patch cables, network racks, and other incidental and miscellaneous premises wiring system hardware as required for a complete and usable system. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
   2. Provide and install (1) 12-strand single mode fiber-optic cable and (1) 25-pair Category 3 copper tie cable from the MDF to each IDF.
   3. Provide and install building entrance terminals as required.

1.4 QUALITY ASSURANCE

A. Acceptable manufacturers:
   1. The equipment/products described herein, and furnished per these specifications shall be the product of one manufacturer. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required
   2. The approved installer shall provide a complete Category 6 solution with a 25-year extended product warranty and application assurance.
   3. Acceptable product connectivity and cable shall be Uniprise by CommScope.

Only the manufacturers listed in this paragraph will be accepted.

B. Installer Qualifications:
1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) similar size, Category 6 and/or Category 6A projects and contact names confirming successful premises wiring system installations.
2. The SCS Installer shall be a certified CommScope Uniprise and in good standing in the Partner Program, local area, integrator and must be able to provide the manufacturer's maximum available warranty on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.
3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
4. All individuals installing the SCS must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project an
5. d submitted in the contractor's product submittals.
6. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.

C. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant and individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.

D. Acceptance:
1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

E. Warranty:
1. The selected system installer shall be a CommScope Uniprise, certified contractor and hold current certification. Contractor shall provide an end-to-end performance warranty of not less than twenty (25) years on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Category 6 and Category 6A cable links have been tested bi-directionally (end to end) using a Level 2 tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-C and/or TSB-67 Link values.
2. The warranty will also cover fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.5 REGULATORY REQUIREMENTS

A. Standards: All work shall be performed in accordance with the latest revisions of the

following standards and codes:

1. Latest Local Codes and Amendments
2. 2012 National Electrical Code

B. Other References:

1.	TIA/EIA-568-C	Commercial Building Telecommunications Wiring Standard
2.	EIA/TIA-569	Commercial Building Standard for Telecommunication Pathways and Spaces.
3.	TIA/EIA-606	The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
4.	TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications.
5.	EIA/TIA 455-A	Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
6.	TIA/EIA TSB 67	Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
7.	TIA/EIA TSB 72	Centralized Optical Fiber Cabling Guidelines
8.	ISO/IEC 11801	Generic Cabling Standard
9.	EN 50173	Generic Cabling Standards for Customer Premises
10.	ANSI/EIA/TIA 526-14	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.6 ABBREVIATIONS

A. The following abbreviations are used in this document:

DC	Direct Current
IDF	Intermediate Distribution Frame
MDF	Main Distribution Frame
PBX	Private Branch Exchange
UTP	Unshielded Twisted Pair

1.7 SUBMITTALS

A. Project Initiation:

1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
   a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
   b. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided

c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.

d. Testing: Proposed Contractor Category 6 UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.

e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

f. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.

1) BICSI RCDD Certification: This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the projected.

2) Proposed Manufacturer's Strategic Partner Certification: This certification have been obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.

3) Proposed Manufacturer's Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.

4) Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.

B. Shop Drawings:

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:

a. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.

b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:

1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)

2) Location of sleeved wall pass-thru

3) Size of sleeve at each location installed

4) Quantity of cable passing through each sleeve

5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)

6) Conduit routing, size, quantity, and stub-up locations for all floor

mounted outlets.

c. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

C. Close-out Procedures:

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
   a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
   b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
   c. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
   d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed, a list of recommended spare parts.
   e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
   f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
   g. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2019 or later. Provide the Owner with electronic versions of the As-Builts on (2) 8GB thumb drives.
   h. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
   i. A copy of the manufacturer's warranty on the installed system.
   j. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
   k. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
   l. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included

systems and equipment. Minimum amount of training time shall be at least 4 hours.

m. One (1) 30” x 42” laminated floor plan sheets illustrating technology drops and cable designation. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF and/or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.

B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.

C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements listed under section 1.5.

D. Ratings: All products shall be new and brought to the job site in the original manufacturer’s packaging. Electrical components (including innerduct) shall bear the Underwriter’s Laboratories label. All communications cable shall bear flammability testing ratings as follows:
CM Communications Cable
CMP Plenum Rated Communications Cable
CMR Riser-Rated Communications Cable

E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
1. Approved Products
a. Twisted-pair cable: Dyna-Blue
American Polywater

G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
1. Approved Products
a. 3M or
b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) CATEGORY 6 TERMINATION HARDWARE

A. Equipment Racks/Cabinets:

Provide and install equipment racks and/or cabinets in locations indicated on the attached drawings for the following areas.

For all IDF and MDF locations:

Contractor shall provide and install new Chatsworth floor mounted rack systems. Refer to floor plan and enlarged MDF/IDF room layouts for number or racks to provide at each location.

1. Approved Products
   a. Floor mounted racks – Chatsworth 55053-703

For IDF rooms that are not dedicated spaces or have public access, provide
1. Wall mounted cabinet – Chatsworth part number 13492-772.

B. Distribution Rack/Cabinet Grounding

All Racks and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.
1. Approved Products –Grounding Compression Lugs
   NSi #L6N-14
2. Approved Products – Wall Mount Bus Bar (one per MDF/IDF location) Hoffman #DGTB412

C. Fiber Optic Patch Panels

The enclosures used shall provide termination panels for LC type connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19” rack mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.

1. Approved Products (for MDF/IDF locations):

   a. CommScope 2U Fiber Shelf 760251045 EPX- 2U-PNL-ENC
   b. CommScope 4U Fiber Shelf 760251049 EPX- 4U-PNL-ENC
   c. CommScope 12 Fiber Inserts LC Single-Mode 760067165 | PNL-BK-012-SFA-LC02-BL-Shuttered
   d. CommScope Wall Mounted Single Sided Single Door Fiber Enclosure 769248905 | WB2-EMT-BK-2P-PNL
   e. Provide cable grommets AMP #559496-2, or equivalent cable grommet.

D. Category 6 Patch Panels: The Category 6 data station cable shall be terminated on Category 6 RJ45 patch panels with circuit board construction, T568B terminations. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

1. Approved Products:
   a. CommScope Category 6 Patch Panels 24 Port 760207274 | CPP-UDDM-M-1U-24
   b. CommScope Category 6 Patch Panels 48 Port 760207282 | CPP-UDDM-M-2U-48
   c. Provide cable support bars at the back of all patch panels to provide additional support at rear of rack and panels

E. Category 6A Patch Panels: The Category 6A Wireless Access Point (WAP) station cable shall be terminated on Category 6A RJ45 patch panels with circuit board construction, T568B terminations. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568AS standards.

1. Approved Product
   d. CommScope Category 6 Patch Panels 24 Port 760207274 | CPP-UDDM-M-1U-24
   e. CommScope Category 6 Patch Panels 48 Port 760207282 | CPP-UDDM-M-2U-48
   a. Provide cable support bars at the back of all patch panels to provide additional support at rear of rack and panels.

F. Cable Management Panels
Provide cable management panels as required for horizontal and vertical cable management. Provide vertical wire management on ends and in between all racks on entire project. All vertical cable managers on the entire project shall be 10” wide management.

1. Approved Products

   Horizontal – Hoffman DCHD2 (Verify with district prior to ordering)

   Vertical – Hoffman DV10DF7
   Provide Velcro straps for cable dressing in MDF/IDF rooms.

G. Rack/Cabinet Electrical:

1. A power distribution strip shall be installed vertically at the back of each data rack and/or cabinet.
   Approved Products
   a. Chatsworth P-11D0A5 120V 20A
   b. Provide a PDU offset bracket for each PDU installed.

- Provide the following electrical UPS equipment at each location indicated.

At MDF room: (Provide quantity of two (2) each of the following at the MDF)

Smart-UPS 3000VA USB & Serial RM 2U 120V
APC Product Number: DUA3000RM2U (black chasis)

UPS Network Management Card 2 with Environmental Monitoring
APC Product Number: AP9631

3 year extended warranty
APC Product Number: WBEXTWAR3YR-SP-04

At IDF Room: (Provide quantity of one (1) each of the following at each IDF)

Smart-UPS 3000VA USB & Serial RM 2U 120V

APC Product Number: DUA3000RM2U (black chasis)

UPS Network Management Card 2 with Environmental Monitoring
APC Product Number: AP9631

3 year extended warranty
APC Product Number: WBEXTWAR3YR-SP-04

H. Network Rack Patch Cables: Cabling Contractor shall provide district with (1) – 6' Category 6 patch cable for each data drop and (1) – 6' Category 6A for each WAP drop on entire project.. These cables will provide connectivity from the front of the network patch panels to the network equipment provided by district upon move-in. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.
1. Approved Products: CommScope 6' Category 6 Patch Cable
   a. Blue in color for all data drops on the entire project UC1BBB2-0ZF006
   b. Green in color for all IP Cameras drops on the entire project UC1BBB2-0MF006
2. Approved Products: CommScope 6' Category 6A Patch Cable
   a. Yellow in color for all Access Point drops on the entire project UC1AAA2-09F006

2.3 CABLE ROUTING/PATHWAY

A. Cable Tray: Metal cable tray shall be provided to affix to the top of all floor mount racks. Cable tray shall be used to brace racks to walls and to route cable from walls to racks in communication closets.
1. Approved Products:
   a. CommScope 760085647 | CR-SLR-10L12W (black)
   b. And all applicable installation accessories and those listed below:
      1. Cable Runway Elevation Kit (CPI) - #10506-706 (black) –one per rack
      2. 3" Channel Rack-to-Runway Mounting Plate CommScope 760084053 | CRR2RRMK (black) one per rack
      3. Cable Runway Radius Drop: CommScope 760083956 | CRDK-12W (black).
      4. Ladder Rack 90° Horizontal E-Bend Section: CommScope 760085530 | CR90FCB-12W (black). Provide as required.
      5. Wall Angle Support Kit: CommScope 760084160 | CR12-C24WRSK (black). Provide as required per ladder tray and wall junction.
      6. End Cap Kit: CommScope 760084012 | CRPECK (black). Provide as required per exposed end of ladder tray
      7. Junction Splice Kit: CommScope 760084046 | CRTJSK (black). Provide as required per junction.
      8. And all applicable installation accessories.

B. Cable Support System:

C. All low voltage cabling shall be installed and supported using a modular cable support system at 48" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.

D. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

E. Innerduct shall be provided for non-armored fiber cabling and shall be bright orange and labeled and shall be provided for fiber optic cables from fiber patch panel to conduit or plenum and conduit entrances. Innerduct installed in plenum rated ceilings shall be

plenum rated.

1. Approved products
   a. Carlon
   b. Dura-line

2.4 FIBER OPTIC PRODUCTS

A. Fiber Optic Cable shall be UL listed type OFNP (unless noted otherwise):

1. Single-mode:
   a. Single-mode fibers, each with a color-coded PVC tight buffer (unless noted otherwise) shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
   b. Approved Products:
      i. 12-strand Single-mode, with plenum rated armored jacket shall connect each IDF with the MDF as specified on Technology Plans.
      i. CommScope Product #760127803 | P-012-DZ-8W-FSUYL
      ii. 12-strand Single-mode, with an indoor/outdoor plenum rated jacket, with no metallic elements, shall connect each IDF (that is not connected to the main buildings) with the MDF as specified on Technology Plans. CommScope Product #760037192 | P-012-OD-8W-FSUBK

3. Provide 4 qty. CommScope 3-meter patch cords for each backbone fiber installed on the entire project. Coordinate the required connector type, on the equipment end, with the owner prior to procuring the products.

4. No fusion or mechanical splices will be allowed at any point in the fiber optic runs.

B. Connectors

Optical Fiber Connectors shall be LC type connectors.

1. Approved Products:

CommScope LC Single-Mode #760117895 | SFC-SLCF-09-8X Qwik II LC

2.5 STATION WIRING

A. Wireless Access Points shall be cabled with Category 6A unshielded twisted pair, four-pair, 24 AWG solid sopper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for WAP Locations.
1. Approved Products: For all WAPs:
   a. Plenum-Rated CommScope Category 6A (Yellow color for all Access points drops on entire project)
      1) CommScope Part # CS44P-YEL

B. Wire: The data and voice wire provided for all outlets shall be (Category 6) unshielded twisted pair, four-pair, 24 AWG solid copper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for number of active data ports to specified faceplates.
1. Approved Products: For all voice and data connections:
   1. Plenum-Rated CommScope Category 6 (blue color for all voice/data drops on entire project)

2) CommScope Part #CS37P BLU

b. Plenum-Rated CommScope Category 6 (green color for all IP Cameras drops on entire project)

3) CommScope Part #CS37P GRN

C. Indoor/Outdoor Plenum Copper cable- For those locations where we will need to run short runs of copper cable from building to building or within a “wet environment” (in slab) provide the following cables:

2. Approved Products: For all voice and data connections:

a. CS34P-IO Indoor/Outdoor Category 6 U/UTP, Plenum, Outdoor Rated, Black Jacket, 4 Pair Count

b. CS44P-IO Indoor/Outdoor Category 6A U/UTP, Plenum, Outdoor Rated, Black Jacket, 4 Pair Count

D. Testing: The Category 6 four-pair UTP cable must be UL Performance Level tested. Each 1000 foot spool must be individually tested with test results affixed to the spool. All cable must be provided on new 1000 foot spools. NO “SHORTS” WILL BE ALLOWED. IF SHORTS ARE DISCOVERED, THE CONTRACTOR WILL BE REQUIRED TO UNINSTALL ALL CABLE ON THE ENTIRE PROJECT AND INSTALL NEW CABLE AT NO ADDITIONAL COST TO THE OWNER.

E. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non plenum rated otherwise.

F. Provide 10 feet service loop at all headend locations properly supported above ceiling. Provide 3’ service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.

G. All cable shall be bundled with Velcro from patch panel to outlet. Velcro shall be rated for plenum space.

2.6 STATION HARDWARE

A. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6A RJ45 modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6 connecting hardware.

1. Approved Products – WAP Jacks:

a. Wireless: CommScope UNJ Series #UNJ600T-YL

b. Wireless: CommScope USL series

B. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6 RJ45 modular jacks with circuit board construction and IDS style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6 connecting hardware.

1. Approved Products – Data and Voice Jacks:

a. Data/Voice: CommScope UNJ Series # UNJ600T-BLU or USL Equivalent

b. Security: CommScope, UNJ Series # UNJ600T-GR or USL Equivalent

2. All blank inserts shall be Gray.

C. Faceplates: Faceplates shall be a 4-port, flush mounted, **stainless steel**, CommScope Semtron solution, for RJ45 outlets at all locations.

1. Approved Products:

a. M10L-262 (Single Gang with label)

b. M14L-262 (Quad Gang with label)

c. M10W4SP (Single Gang for wall mount phone)

D. Workstation Patch Cables: Cabling Contractor shall provide district with (1) – 10' Category 6 patch cable for each data drop on entire project. One 10' Category 6A patch cable for each WAP drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration.

E. Approved Products: CommScope Uniprise 10' Cat 6 or Cat 6A Patch Cable
1. Blue in color for all Access Point drops on the entire project UC1BBB2-0ZF010
2. Green in color for all IP Cameras drops on the entire project UC1BBB2-0MF010
3. Yellow in color for all Access Point drops on the entire project UC1AAA2-09F010

PART 3 - EXECUTION

3.1 GENERAL

A. Fire Wall Penetrations: The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.

B. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.

C. Cable Lubricants: After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.

D. Pull Strings: Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.

E. Conduit Fill: Conduit fill shall not exceed 40%.

F. Damage:
1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.

G. Clean Up:
All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

A. Labels

The Contractor will label all outlets using permanent/legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least on-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.

The following nomenclature should be used when labeling data/voice jacks:

a. All cables being served by MDF closet shall begin with 'M' all IDF served cables shall begin with I# (# designated IDF closet number).

b. Next identification letter shall refer to patch panel that is serving outlet (A,B,C…)

c. Next identification shall note what # data port on patch panel (1 thru 48).

Example:

a. Outlet from 23rd port of the third patch panel from top of rack located at IDF2-C23
b. Outlet from the 5th port of the second patch panel from the top of rack located at MDF M-B5

B. Floor Plan

A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.

C. Contractor shall label wiring on both ends of cable at workstation and headend locations with machine labels, no exceptions.

3.3 EQUIPMENT RACK CONFIGURATION

A. Equipment Racks: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements. Placement of racks must be approved prior to installation. **Racks installed without Owner's acceptance of location shall be relocated including all related work at no cost to the Owner.**

B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel, also 1 per patch panel should be left at site to accommodate the switch gear when they are installed. Vertical cable management panels shall be installed on each side of the rack. In instances where more than one rack is installed in a single location, vertical cable management shall be installed between the racks and on either side.

C. Cable Placement: Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.

D. Cable Routing: Cable shall be routed as close as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within

the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

E. Installation: All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

F. Hardware: Provide rack and jack panel hardware as required for all data station wiring.

3.4 STATION WIRING INSTALLATION

A. General:
1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed enhanced Category 6 UTP cable at either the wiring closet or the workstation termination locations.

B. Exposed Cable:
1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings.
2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.

C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.

D. Cable Routes:
1. All cabling placed in ceiling areas must be in conduit, cable tray or J-Hooks. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section.
2. Attaching cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Chatsworth hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable rings on 36-inch maximum centers to hang cable. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling. Grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple cables to be bundled together every 6 feet.

3.5 STATION HARDWARE

A. Flush Mount Jacks: Flush mount jacks shall be mounted in a faceplate with backbox.

B. Placement: Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.

C. RJ-45 Jack Pin Assignments:
1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring).

3.6 CABLE TESTING REQUIREMENTS

A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.

B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.

E. Twisted Pair Cable Testing:
1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Category 6 products shall be tested for compliance to ANSI/TIA/EIA 568A and ISO/IES 11801 for a Category 6 rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
2. Each wire/pair shall be tested at both ends for the following:
   a. Wire map (pin to pin connectivity)
   b. Length (in feet)
   c. Attenuation
   d. Near end cross talk (NEXT)
   e. Power Sum
3. Test equipment shall provide an electronic and printed record of these tests.
4. Test results for each Category 6 four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts associated with that cable.

F. Fiber Optic Cable Testing

1. Optical fiber cabling shall be tested and certified after installation as described below and as required for cable manufacturer's warranty. Fiber testing shall be performed on all fibers in completed end to end system. Testing shall consist of a bi-directional end to end test in accordance with applicable standards in 27 02 20.20, or a bi-directional end to end test performed by TIA-455-53A and all other applicable standards in 27 02 20.20. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode type glass and 1310 and 1550 nanometers for single-mode type glass. These tests shall also include

continuity checking of each fiber. For spans greater than 90 meters, each tested span must test to a value less than or equal to value determined by calculating a link loss budget. For horizontal spans less than or equal to 90 meters, each tested span must be less than or equal to 2.0 decibels. The insertion loss for each mated optical fiber connector pair shall not exceed 0.40 decibels.

2. Pre-installation testing: Test all optical fiber cable for all fibers prior to installation of cable.
3. Performance testing: Where links are combined to complete a circuit between devices, Contractor shall test each link from end to end to ensure performance of system. Only a basic link test is required. Contractor can optionally install patch cords to complete circuit and then test entire channel. The test method shall be same used for test described above. The values for calculating loss shall be those defined in applicable TIA standards in Appendix 1: Codes, Standards, and Informative References.
4. Attenuation testing: Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach test equipment to cable plant. The light source shall be left in place after calibration and power meter moved to far end to take measurements.
5. Loss budget: All fiber cabling shall be tested at both wavelengths 850 nm and 1310 nm for multimode and 1300 nm and 1550 nm for single mode.
    a. The link attenuation shall be calculated using:
        1) The CommScope Fiber Performance Calculator for CommScope installations
        2) The following calculation for other installations:
        Link Attenuation Allowance (dB) = Cable Attenuation (dB) + Connector Loss (dB) + Splice Insertion Loss (dB)
        Where:
        Cable Attenuation (dB) + Cable attenuation (dB/km) X Length (km)
4. Link Loss: A mated connector to connector interface shall be considered a single connector. Loss numbers for installed link shall be calculated by taking sum of bi-directional measurements and dividing that sum by two. All links not meeting requirements of standard shall be brought into compliance by Contractor, at no additional cost to Owner.
7. Documentation: Following final documentation shall be submitted to the owner's representative prior to commissioning data system and final contract payment according to Submittals in this section.
8. Test results: Test results shall be automatically evaluated by equipment, using most up-to-date criteria from all applicable standards specified in 27 02 20.20 and result shown as pass/fail. Test results shall be printed directly from test unit or from a download file using an application from test equipment manufacturer. The printed test results shall include all tests performed, expected test result and actual test result achieved.
9. End to End Loss Data: final documentation shall be submitted to the owner's representative.
10. As Installed/ As Built Diagrams: Final documentation shall be submitted to the owner's representative.
11. Test Documentation shall be submitted in electronic format. Certification Test Reports shall be submitted in electronic format using the appropriate software supplied by the test equipment manufacturer. The data format should be that of the test report software (i.e. *.flw files for Fluke). The contractor shall provide any necessary software to view and evaluate the test data.

3.7 INSPECTION

A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.
   1. Written Test Report:
      a. Complete test results, including actual values associated with tests.
      b. Show all certifications for telecommunications wiring systems.
      c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCad format. Provide electronic copy of drawings to owner in AutoCad version 14 or greater.
      d. Documentation of outlet, cable and rack labeling system.

B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed and test results certify system to all specified standards.

END OF SECTION 27 10 00

SECTION 27 41 00 - AUDIO-VIDEO SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

Architectural, structural, mechanical, electrical, and other applicable documents and drawings are considered a part of the Audio-Video Systems and Equipment documents insofar as they apply, as if referred to in full.

Audio-Video Systems drawings EAV0.01 through EAV9.01, Tomball ISD Multi-Program Activity Center, Issued for Permit, are a part of this Section.

SUMMARY

This Section, together with the related drawings and General Conditions of the Contract, comprises the requirements for the Audio-Video Systems for the Tomball ISD Multi-Program Activity Center (MPAC), Tomball High School, 118 Baker Drive, Tomball, Texas 77375. The Audio-Video Systems (hereafter referred to as AV Systems) include, but are not limited to, the following:

Indoor MAC Field Distributed Sound System: Thirty (30) deck-suspended, down-firing two-way loudspeakers in five (5) rows over Indoor MAC Field F101, wired as ten (10) low-impedance circuits of three (3) loudspeakers each and powered by networked amplifiers, as indicated on the drawings.

Audio Matrixing, Processing, and Control System: Networked DSP/control core located in equipment rack ER1 (IDF 105) providing processing, zoning, source routing, paging, fire alarm override, power sequencing, and control of all AV Systems.

Wireless Microphone System: Dante-networked digital UHF wireless microphone receiver with handheld and bodypack transmitters and two (2) remote wall-mounted active directional antennas.

Wall Plate Audio Inputs: Four (4) PoE wall plate encoders providing HDMI, USB-C, and Bluetooth audio input to the system at locations around the Indoor MAC Field.

Audio Playback: Rackmounted CD / SD / USB / Bluetooth / AM-FM playback device at ER1.

Control System: Two (2) 10-inch PoE touch panels (one wall-mounted, one rackmounted at ER1) and wireless control from a Division 27-furnished iPad tablet over a dedicated AV wireless LAN.

Dedicated AV Network: Managed PoE+ network switch at ER1 and two (2) Wi-Fi 7 wireless access points for the AV LAN.

Equipment rack, power conditioning, switched power distribution, uninterruptible power supply, and associated hardware.

Loudspeaker rigging, including steel framing channel and suspension hardware anchored to structure.

Ancillary devices related to the AV Systems including, but not limited to, processing, amplification, microphones, jacks, wire, connectors, and other miscellaneous parts required for complete and operational systems.

SCOPE OF THE WORK

Furnish, deliver, erect, install, and connect completely all of the material and appliances described herein and in the Drawings, and supply all other incidental material and appliances, tools, transportation, etc., required to make the work complete, and to leave the AV Systems in first-class operating condition, excluding those items listed under Article 1.12, RELATED WORK IN OTHER SECTIONS.

Perform all assembly of equipment, wiring, inter-connection, and soldering of wires to jacks, devices, terminals, or equipment, using technical employees only, who are experienced in the installation of AV System equipment and its inter-connection. Coordinate final utility rough-in locations with actual equipment furnished.

Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturers' recommendations, and all applicable code requirements.

RELATED WORK

Division 26 - Electrical.

Section 27 05 29 - Hangers and Supports for Communications Systems.

Section 27 10 00 - Structured Cabling (Datacomm).

Division 28 - Fire Detection and Alarm.

Section 13 34 19 - Metal Building Systems.

Section 07 84 00 - Firestopping.

Section 09 90 00 - Paintings and Coatings.

REFERENCES

NFPA 70 - National Electrical Code (NEC), current edition adopted by the Authority Having Jurisdiction.

NFPA 72 - National Fire Alarm and Signaling Code.

ANSI/TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard.

ANSI/TIA-569 - Telecommunications Pathways and Spaces.

ANSI/TIA-606 - Administration Standard for Telecommunications Infrastructure.

ANSI/INFOCOMM 10:2013 - Audiovisual Systems Performance Verification.

ANSI/AVIXA 2M-2010 - Standard Guide for Audiovisual Systems Design and Coordination Processes.

IEC 60268-16 - Objective Rating of Speech Intelligibility by Speech Transmission Index.

2010 ADA Standards for Accessible Design.

FCC Part 15 and Part 74 - Rules governing unlicensed and licensed wireless microphone operation.

UL 60065 / UL 62368-1 - Safety requirements for audio, video, and information technology equipment.

QUALITY ASSURANCE

The intent of this Section is to describe and provide for complete AV Systems of high professional quality and reliability. Professional performance standards by the AV Systems Contractor (hereafter referred to as Installer) and the equipment will be required.

In all cases, the Owner and Architect shall determine the acceptability of the work based upon the visits, observations, and reports of the AV Systems Consultant, Technical Design Group (hereafter referred to as Consultant).

INSTALLER QUALIFICATIONS

The work performed under this Section shall be performed by an AV Systems contractor normally engaged in the business of AV Systems installation. The prospective contractor shall show proof, as part of the bid, that the contractor has been in the AV Systems installation business for a period of not less than five (5) years and has successfully completed projects of similar size and scope.

All work shall be performed by employees of the AV Systems subcontractor, and not by contract employees. Work crew(s) must be supervised by a technician holding a current AVIXA CTS-I certification, or equivalent.

Each bidder shall hold a current, valid franchise for the major lines of audiovisual equipment furnished under these Specifications. When factory training and certification is required for a given product, the Installer shall present written proof of certification.

The Owner and Architect reserve the right to reject any bids submitted by firms without sufficient experience in projects of similar size and scope.

All installation technicians and programmers shall hold current manufacturer certifications for the systems they install or program, including QSC Q-SYS Level 2 and Q-SYS Control, Audinate Dante Level 3, and Powersoft ArmoníaPlus. Rigging of loudspeakers shall be performed under the supervision of personnel holding current ETCP Certified Rigger - Arena certification, or equivalent documented rigging training.

SUBSTITUTIONS

Refer to Division 01 for specific substitution procedures and submittal requirements.

Many items are listed in the Specifications by the manufacturer's type or model number, without a detailed performance specification, and may not include the phrase "or approved equal". Where this is the case, no substitutions will be accepted.

Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance, based on the published specifications of the manufacturer and on the actual performance as known by the Consultant. Requests for substitution shall be submitted in writing and forwarded to the Consultant no less than five (5) business days prior to the project's scheduled bid date. No substitution will be accepted without written approval from the Consultant to the Installer.

Requests for substitution, when forwarded by the Installer to the Consultant, are understood to mean that the Installer represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified, that the same guarantee will be provided for the substitution as for the specified product, and that the Installer will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.

Substitutions will not be considered if they are indicated or implied in Shop Drawing submissions without previous formal request, or if, for their implementation, they require a substantial revision of the Contract Documents in order to accommodate their use.

Space allocations, structural loads, and utility rough-ins have been designed on the basis of equipment items named by manufacturer and model number. If any equipment not so named is offered which differs substantially in dimension, weight, or configuration from the named equipment, provide scaled shop drawings showing that the substitute can be installed in the space available without interfering with other trades or with access for operation and maintenance in the completed project. Substitute loudspeakers shall be submitted with weight and rigging point data for structural review.

Many Basis of Design products are specific as to infrastructure requirements, and such infrastructure has been specifically designed for the Basis of Design products listed. Where substitute equipment requiring different arrangement or connections from those shown in the Contract Documents is accepted by the Consultant, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, making all necessary incidental changes without increasing the Contract amount. Facilitate revisions and modifications with impacted disciplines and trades, and pay all additional costs incurred by adjoining or connecting trades for implementation of such modifications.

Where a specified product has been discontinued by the manufacturer at the time of procurement, submit the manufacturer's direct current-production replacement for Consultant review. Such replacement shall meet or exceed the published performance, channel count, network protocol, and physical dimensions of the specified product.

COOPERATION AND COORDINATION

Cooperate and coordinate as required with the other contractors who are responsible for work not included in this Section.

Provide any and all information as required or requested by the Owner, Architect, Consultant, or General Contractor in order for this work to be completed to the satisfaction of the Owner, and in the best interests of the Project. Such assistance or information shall be transmitted in writing to the requesting party in all cases. All written correspondence shall be copied to the Consultant.

Coordinate with the Tomball ISD Technology Department for IP address assignments, VLAN configuration, wireless SSID and security policy, and any hand-off between the AV network and the District network at the ER1 building data outlets.

Coordinate loudspeaker rigging attachment points, loads, and methods with the General Contractor, the metal building system manufacturer, and the Architect's structural engineer prior to fabrication of rigging hardware.

GUARANTEE AND WARRANTY

Guarantee all parts, labor, and workmanship furnished under this Contract for a period of twelve (12) months from the date of Substantial Completion.

During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 48 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.

Where warranties on individual pieces of equipment exceed twelve (12) months, the guarantee period shall be extended to the warranty period of the particular items.

Furnish complete and working AV Systems. Be of maximum assistance to the Owner during the guarantee period of the system, to the degree that maximum Owner satisfaction is assured.

After completion of the work, the Installer shall submit a Certificate of Warranty, stating commencement and expiration dates and conditions of the warranty, for signature of both parties. Incremental warranties for completed portions of the work may be negotiated at the discretion of the Owner if delays occur beyond the control of the Installer.

SUBMITTALS

Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Electronic files of drawings will be made available to the Installer from the

Consultant at a cost of $500.00. A signed electronic files disclaimer and a purchase order from the Installer in this amount is required before electronic files will be released. The available drawings shall include only: (1) Device legend / advisory power and data requirements, (2) Conduit riser, (3) Floor and reflected ceiling plans, (4) Section views. Drawings shall be prepared and submitted in DWG and PDF formats, and as directed by the Architect. Equipment lists, data sheets, etc. shall be 8-1/2" x 11" size, properly bound into a single or multiple volumes as necessary, or submitted in electronic PDF format. Submit quantity in accordance with Division 01, General Requirements.

Within 45 days after the Notice to Proceed, submit to the Architect identical copies of the following for approval:

A complete equipment list, with manufacturers' names, model numbers, and quantities of each item.

Manufacturers' data sheets on all equipment items.

Equipment rack layouts showing locations of all rack-mounted equipment items.

Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8" = 1'-0", showing loudspeaker locations and orientation, junction box and wall plate locations, and all other related device locations.

Loudspeaker rigging submittal: Proposed rigging details for all S1 and S2 loudspeakers, including steel framing channel, attachment to structure, hardware ratings, secondary safety cables, loudspeaker weights, and point loads at each attachment. Rigging details and attachments to the building structure shall be reviewed and accepted by the Architect's structural engineer and the metal building system manufacturer prior to fabrication. Where required by the Architect or Authority Having Jurisdiction, rigging calculations shall be signed and sealed by a professional engineer licensed in the State of Texas.

Proposed construction details for any manufacturer-supplied, third-party, and custom-fabricated items, including rack plates, wall plates, antenna mounts, and loudspeaker mounts. These details shall show dimensions, materials, finishes, and color selection.

Coordinate with the Architect / Owner regarding color selection of each equipment item and associated mount / mounting hardware for any and all exposed devices. Provide factory color options for review in the submittal package. The Installer shall request written confirmation from the Architect / Owner on all such devices prior to ordering. Where the Architect's color selection is not a factory color option, the Installer shall coordinate with the device manufacturer for custom color/paint, where available, and, if not available, coordinate with the General Contractor and other trades for field painting.

Comprehensive system schematics, showing detailed connections to all equipment, with wire numbers, terminal block numbers, and color coding.

Riser diagrams showing conduit requirements with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.

Electrical power requirements for head-end and ancillary equipment. Include diagrams for remote control of electrical power, in sufficient detail to coordinate with the Electrical Contractor, showing exact conduit requirements and locations for power service receptacles.

Network design submittal including switch configuration, VLAN schedule (Q-LAN / Dante audio, AV-over-IP, control, wireless AV LAN, and management), QoS / DSCP settings, IGMP snooping configuration, IP address schedule, PoE budget calculation, and PTP clocking plan.

Wireless microphone frequency coordination plan, based on the site RF scan described in Part 2.

Q-SYS design file and touch panel user control interface (UCI) screen captures, submitted for Consultant review a minimum of four (4) weeks prior to the scheduled commissioning trip.

Certain other submittals as noted elsewhere in this Specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.

Submission of the AV Contract Documents / Bid Documents does not constitute a legitimate submittal and will not be accepted.

Incomplete submittals will not be reviewed. Complete Shop Drawings and Product Data shall be submitted as a single submittal.

All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Submit the following in accordance with Division 01, General Requirements. The Installer shall provide final documentation in both hard copy and electronic formats. Suitable electronic formats include Microsoft Word and Excel, Autodesk (.dwg, .dwf), and Adobe Acrobat (.pdf).

A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, MAC addresses, IP addresses, and quantities of each item.

A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codes. System performance measurements as noted elsewhere in this Specification shall be documented. Include diagrams or charts showing final settings of all control knobs in the system (mixers, equalizers, power amplifiers, etc.). Submit copies of software settings of each piece of equipment that is software controlled.

Complete equipment rack layouts showing locations of all rack-mounted equipment items.

Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8" = 1'-0", showing loudspeaker locations and orientation, wall plates, rack locations, and other related device locations.

Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.

Repair parts lists for each and every major equipment item furnished.

Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the Certificate of Warranty, signed by both parties.

Technical Systems Operations Manual, custom-written by the Installer, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.

Category 6 permanent link certification reports, final switch and wireless access point configuration files, final Q-SYS design file, and final amplifier configuration files.

Incomplete submittals will not be reviewed.

RELATED WORK IN OTHER SECTIONS

All conduits with pull strings, all electrical pull boxes, all junction boxes (including JB and JR), and all outlet boxes shall be furnished and installed under Division 26, as indicated on drawings EAV0.01 and EAV0.03. Coordinate as necessary for proper installation.

All 120VAC power conductors and conduits associated with power circuits to all equipment locations shall be furnished and installed under Division 26. The 120VAC power to equipment rack ER1 shall be terminated inside the rack to the isolated-ground receptacle modules furnished under this Section.

An insulated THW stranded copper ground wire, sized according to NEC, shall be installed under Division 26 from the equipment rack sheet metal to the primary ground point within the building, and terminated at each end to bare metal using approved connectors and clamps.

A dedicated K-13 rated, electrostatically shielded isolation transformer with copper windings, double-size neutral terminal, and transient voltage surge suppression, and a dedicated AV system power distribution panel, shall be furnished and installed under Division 26, as indicated on drawing EAV0.02. The transformer shall not be located within 14 feet of AV equipment locations.

Advisory electrical circuits shown in the AV System drawings are for reference only in depicting the number of electrical circuits needed for operation of these systems.

Advisory datacomm circuits shown in the AV System drawings associated with the building data network are for reference only in depicting the number of network drop locations needed for operation of these systems.

Two (2) building data outlets at equipment rack ER1 shall be provided under the Datacomm Section.

Datacomm circuits associated with the dedicated AV data network are wholly within the Installer's scope of work, as specified in this Section and shown in the accompanying drawings.

Recessed or integrated loudspeaker back-cans, where required by substitute equipment, shall be furnished under this Section and installed under Division 26. All other enclosures and boxes associated with AV scopes of work, as called out in the Audiovisual Device Legend, shall be furnished and installed under Division 26, unless explicitly noted otherwise.

Wall blocking for wall-mounted devices, and structural framing members required for loudspeaker rigging attachment, shall be provided under other Divisions. Steel framing channel and suspension hardware for loudspeakers shall be furnished and installed under this Section.

Fire alarm system all-call / voice evacuation interface: A dry contact closure shall be provided under Division 28 at ER1 and terminated by this Section to a DSP1 GPIO input for automatic muting of the AV Systems during fire alarm activation.

Firestopping of penetrations through fire-rated assemblies shall be provided under Division 07 and Division 26, as applicable.

The District network, and any additional Owner-furnished computers, tablets, or mobile devices used to control the system, are not in contract. The iPad control tablet shown on drawing EAV9.01 is furnished under this Section.

PART 2 - PRODUCTS

GENERAL

All items shall be new and unused.

The following articles specifically list the acceptable equipment types and items for this project. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the Specifications and the Drawings, the greater quantity or better quality shall be furnished.

Refer to Article 1.8, SUBSTITUTIONS, of this Section.

WIRE AND CABLE

All wire and cable shall be new and unused.

Wire not installed in equipment racks, not portable, or not installed in conduit shall be fire-rated and meet all applicable codes. Plenum-rated (CMP) cable shall be used where installed without conduit in air-handling spaces; cable installed in conduit may be standard riser-rated (CMR) or PVC-jacketed.

Conduit shall be required between any and all loudspeakers, per drawing EAV0.01. Where plenum-rated loudspeaker cable is allowed by code, the Consultant will consider substitution requests submitted formally by the construction team, approval of which is subject to the best interests of the Project.

Furnish and install the following, in quantities and lengths as required. Equivalent cable from other manufacturers may be considered.

Low-impedance loudspeaker cable (S1 / S2 loudspeaker circuits):

West Penn Wire 2210 (or 25210B plenum where required) stranded 10 AWG, 2-conductor, jacketed loudspeaker cable. Provide one (1) 10 AWG home run per loudspeaker circuit from ER1 to the first loudspeaker in each circuit, and 10 AWG parallel connections between each loudspeaker in the circuit, as shown on drawing EAV9.01.

Audio cable:

Microphone- and line-level audio cable: West Penn Wire 452 (or 25452 plenum where required) stranded 22 AWG twisted pair with foil shield and drain.

Control and GPIO cable:

West Penn Wire 224 (or 25224 plenum where required) stranded 18 AWG, 2-conductor, for GPIO and relay control circuits, including DSP1 GPIO Output 1 to the MPR1 relay module chain.

Wireless microphone antenna cable:

For runs less than 50 feet: Belden 9258, 50-ohm RG-8X type low-loss coaxial cable with appropriate BNC connectors.

For runs that exceed 50 feet: Belden 9913F7, 50-ohm RG-8 type low-loss coaxial cable with appropriate connectors.

Data cable (copper) for networked AV systems:

Installed data cable: Category 6, 23 AWG, 4-pair UTP, CMR or CMP as required, Belden 2412 / 2413 or approved equal conforming to the Tomball ISD Technology Department cabling standard. Cable color shall be distinct from the building data network cabling; coordinate color with the Owner.

Data patch cables: Category 6 factory-terminated patch cables of the same manufacturer as the installed cable, or approved equal.

Terminate all field device Category 6 cables at ER1 on a rackmounted Category 6 patch panel or on modular RJ-45 plugs per the manufacturer's requirements. Field terminations shall conform to ANSI/TIA-568.2, T568B.

Extended distance network cable:

Where any Category 6 run between ER1 and a field device exceeds 100 meters (328 feet) channel length, or 90 meters (295 feet) permanent link length, provide Paige GameChanger plenum-rated (CMP) extended-distance Category 6 UTP cable, part number 258300310, 4-pair solid 22 AWG bare copper, supporting 1 Gbps Ethernet to 200 meters (656 feet) and IEEE 802.3 PoE Classes 1-8, in place of the standard Category 6 cable. Per the conduit riser on drawing EAV0.03, this includes BT-3 (West Wall, estimated 350 feet) and AP-2 (West Wall, estimated 330 feet). Confirm actual routed lengths in the field; any other run that exceeds these lengths shall also use this cable.

Terminate extended distance cable with RJ-45 jacks or plugs rated for 22 AWG solid conductors, as recommended by the cable manufacturer. Cable color shall be coordinated with the Owner and match the AV network cable color where available.

Other equipment control cables shall be stranded wire, appropriately shielded, of gauge and number of conductors required by the manufacturer for proper operation of the system or equipment item furnished.

Wire and cable for all other devices shall be supplied in accordance with the recommendations of the device manufacturer and the National Electrical Code.

JACKS, CONNECTORS, AND WALL PLATES

All plate-mounted connectors shall be ground-insulated from the plates on which they are mounted.

For non-standard custom panels and rack plates, connectors shall be installed on 1/8" thick black anodized aluminum or brushed stainless steel panels. Nomenclature shall be engraved into the plate with 1/8" block letters filled with contrasting paint color. Coordinate final finish selection with the Architect prior to Shop Drawing submittals.

All other jacks shall be installed on standard brushed stainless steel finish plates, or on the Decora-style plate furnished with the device, as shown. Nomenclature shall be engraved into the plate with 1/8" block letters filled with black paint.

All AV signal circuit locations shall be numbered logically and consecutively for each circuit/signal type, starting from one (1).

Unless otherwise specified, all jacks and connectors for the AV Systems shall be as follows, or approved equal:

Audio connectors:

Female cable-end audio connectors: Neutrik NC3FX-B 3-pin female XLR connectors with gold-plated contacts.

Male cable-end audio connectors: Neutrik NC3MX-B 3-pin male XLR connectors with gold-plated contacts.

Equipment terminal-block (Phoenix / Euroblock) connections: manufacturer-supplied connectors, with ferrules on all stranded conductors.

RF connectors:

BNC cable-mounted connector (50-ohm): Amphenol Connex 112116 or approved equal crimp connector matched to the cable furnished.

Loudspeaker connections:

Loudspeaker input terminal connections shall be made to the loudspeaker manufacturer's screw terminal blocks using insulated spade lugs or ferrules sized for 10 AWG conductors.

Network data connectors:

RJ-45 Category 6 modular plugs or jacks of the same manufacturer as the installed cable.

Furnish and install the required number of jacks and connectors as indicated on the drawings.

EQUIPMENT RACKS AND POWER DISTRIBUTION

Furnish equipment racks for use in housing AV equipment including, but not limited to, power amplifiers, signal processors, input/output devices, playback equipment, network equipment, and ancillary devices necessary to the operation of the system. Provide a 1/4" (nominal) non-conductive industrial-grade black rubber mat under each cabinet, trimmed to the footprint of the cabinet, for isolation from building structure.

Each equipment rack shall include a locking front door, locking rear door, side panels, and top and bottom panels unless otherwise noted.

Equipment rack colors shall be flat black.

Heat-producing components shall be mounted with one (1) RU blank panel installed between units, or as the manufacturer recommends. Fill all other unused portions of rack front sections with matching blank panels.

Furnish five (5) sets of spare keys for each equipment rack.

All mounting screws shall be theft-resistant.

Configure power sequencing so that power amplifiers are the last to turn on in the system power-up sequence and the first to turn off in the power-down sequence. Sequencing shall be controlled from DSP1 GPIO Output 1 through the MPR1 relay module chain, as shown on drawings EAV7.01 and EAV9.01.

Furnish and install the following, or approved equal:

Floor-mounted equipment rack (ER1, IDF 105): Middle Atlantic Products WRK-44-32LRD, 44RU, 24-1/4" W x 32" D, with front door, rear door, side panels, rear rack rails, and fan top. Provide all accessories as required for proper installation and support of all devices. Provide one (1) Middle Atlantic WL-60 worklight. (Qty: 1 ea.)

Rack power conditioner (PDX1): Middle Atlantic Products NEXSYS PDX-920R-SP, 1RU, 9-outlet, 20A, located at the top of rack ER1. (Qty: 1 ea.)

Uninterruptible power supply (UPS1): Middle Atlantic Products NEXSYS UPX-RLNK-2000R-2, 2RU rackmount, 2000VA/1800W line-interactive with automatic voltage regulation, pre-installed RackLink network card for remote monitoring and management, eight (8) NEMA 5-20R outlets in two (2) controlled banks, and front-access hot-swappable battery. Coordinate 20A input circuit and receptacle with Division 26. Connect DSP1, SW1, and PB1 to UPS-protected outlets. Integrate RackLink status monitoring into the Q-SYS design. (Qty: 1 ea.)

Rear vertical power raceway (MPR1): Middle Atlantic Products MPR-8A, 72-inch, rear-rail mounted, populated with eight (8) Middle Atlantic RLM-20IGA 20A controlled isolated-ground receptacle modules (RLM-1 through RLM-8), each providing two (2) NEMA 5-20R isolated-ground outlets. Modules shall be furnished under this Section for termination by Division 26 to the six (6) dedicated 20A isolated-ground circuits shown on drawing EAV0.02. Daisy-chain module dry contacts and wire Module 1 to DSP1 GPIO Output 1 with 18 AWG, 2-conductor cable for sequenced power-up of amplifier and rack loads. (Qty: 1 ea. raceway; 8 ea. RLM-20IGA)

Brush grommet panel (BR1): Middle Atlantic / Legrand BR1, 1RU, for cable entry from JR above. (Qty: 1 ea.)

Locking storage drawers (DRW1, DRW2): Middle Atlantic Products D3LK, 3RU locking drawer. (Qty: 2 ea.)

Touch panel rack plate: Custom 4RU black anodized rack plate for TP-2, with cutout coordinated to the QSC TSC-101-G3 manufacturer rack-mount / surface-mount bracket kit, per drawing EAV7.01. (Qty: 1 ea.)

Blank panels: Middle Atlantic Products EB1 (1RU) and EB2 (2RU) blank panels to fill all unused rack spaces, as shown on the rack elevation. (Qty: as required)

Rack shelf: Provide Middle Atlantic U1 or U2 utility shelves for any non-rackmountable components. (Qty: as required)

DIGITAL SIGNAL PROCESSING

The audio processing shall be in the digital domain following the input source and shall remain digital until power amplification is required.

The system processor shall be a 1RU networked audio, video, and control processor providing a minimum of eight (8) mic/line inputs, eight (8) line outputs, and eight (8) flex channels of local analog I/O; 160 x 160 network audio channels (Q-LAN / AES67); 24 channels of acoustic echo cancellation; software-based Dante with 8 x 8 channels included, licensable up to 64 x 64; eight (8) GPIO inputs and eight (8) GPIO outputs; eight (8) VoIP softphone instances; and four (4) 2.5 Gbps Ethernet ports, two (2) for redundant networked audio and two (2) independent auxiliary ports.

The system processor shall store a single design which can be comprised of components, wiring, links, text, and graphics on a single or multiple schematic pages. Designs shall include, as required, the following DSP function blocks, test and measurement components, control components, and layout components: Acoustic Echo Cancellers, SIP Softphone instances, Audio Players, Audio Streaming components, Crossfaders, Crossovers, Delay components, Auto Gain Control elements, Compressors, Gates, Duckers, Expanders, Ambient Noise Compensators, Limiters, Gain blocks, Graphic Equalizers, Parametric Equalizers, FIR Filters, All-Pass, Band-Pass, Band-Stop, High-Pass, and Low-Pass Filters, Dual-Shelf Equalizers, Notch Filters, Meters, Matrix Mixers, Gain-Sharing Automatic Mixers, Gated Automatic Mixers, Signal Routers, Public Address Routers, Room Combiners, Signal Presence Meters, Tone and Noise Generators, FFT Measurement Modules, Real Time Analyzers, Signal Injectors, and Signal Probes. The system processor shall support custom user control interfaces on proprietary touch screen controllers, on network computers utilizing a control application, and on iOS devices over Wi-Fi.

Native system control shall be accomplished via local network-connected computer utilizing the manufacturer's control application. The Installer shall program a custom user interface incorporating all end user controls, to include controls and presets for the default system configuration. All program file pages not intended for end-user operational access shall be password-protected.

Provide and install the most current version of the manufacturer's configuration software at the time of installation. All DSP hardware devices shall be updated to the most current firmware version at the time of installation.

Provide all data interconnection cabling as shown, and as required to satisfy the intent of the drawings.

The system programmer shall be certified by the manufacturer of the DSP system provided.

Furnish and install the following, as indicated in the accompanying EAV-series drawings, or approved equal:

Digital signal processor (DSP1): QSC Q-SYS Core 24f. (Qty: 1 ea.; DSP1 at ER1)

Software-based Dante license: QSC SLDAN-16-P (16 x 16) Software-based Dante license, or larger as required, applied to DSP1. The Dante channel count shall accommodate all Dante devices shown, including two (2) amplifiers (ten (10) loudspeaker circuits), the four-channel wireless receiver, and four (4) wall plate encoders, with spare capacity. (Qty: 1 ea.)

The Installer shall be responsible for programming the software configuration file based on intended functionality shown, or implied, in the drawings, including but not limited to:

Routing and level control of all sources (wireless microphones, wall plate inputs BT-1 through BT-4, and PB1) to the Indoor MAC Field loudspeaker system.

Loudspeaker processing for all ten (10) circuits, including high-pass filtering, equalization, delay alignment between rows, and limiting, in coordination with the amplifier DSP presets.

Priority ducking of program sources by microphones.

Fire alarm mute: Automatic mute of all AV Systems outputs upon closure of the Division 28 fire alarm dry contact, with automatic restoration upon release.

Power sequencing via GPIO Output 1, as described in Article 2.4.

Monitoring of amplifier, UPS, network switch, and wireless system status, with fault indication on the touch panel interfaces.

"User" control screens which allow limited control by the end user without access to system schematics. The system shall be programmed so that the default operating condition is auto-populated upon system power-up.

Provide a review copy of the programming file to the Consultant for review no later than four (4) weeks prior to the scheduled commissioning trip.

LOUDSPEAKER ASSEMBLIES

Furnish and install deck-suspended loudspeakers at the locations noted on the drawings, aimed down-firing as shown on drawings EAV2.01 and EAV4.05.

Each loudspeaker shall be suspended from steel framing channel anchored to the building structure, using the loudspeaker manufacturer's U-bracket (yoke) accessory, as shown on details 2 and 3 of drawing EAV8.01. All hardware shall be rated with a minimum safety factor of five (5) to one (1) for the suspended load. Provide an independent secondary safety cable from each loudspeaker to structure. Do not attach to roof deck, purlins, or non-structural members without written approval of the structural engineer and metal building system manufacturer.

Coordinate exact loudspeaker locations and suspension heights with the Architect and other trades, including lighting, sprinklers, HVAC, and netting systems. Field-fit threaded rod and hardware lengths to clear the truss bottom chord.

Verify factory loudspeaker color with the Architect prior to product acquisition. Coordinate with the Architect regarding color selection of exposed rigging hardware.

Wire the loudspeakers of each circuit in parallel as shown on drawing EAV9.01. Measure and record the impedance at 1000 Hz of each home run at the amplifier terminals. The nominal circuit impedance is 2.7 ohms. Include the measurements in the final documentation.

Furnish and install the following, or approved equal:

Type "S1": Community IP6-1122/96B two-way installation loudspeaker, 12-inch LF / 1.4-inch exit HF compression driver, 90° x 60° rotatable waveguide, 8-ohm nominal, 600W continuous passive power handling, black finish, with manufacturer's U-bracket and rigging hardware. (Qty: 25 ea.)

Type "S2": Community IP6-1122/66B two-way installation loudspeaker, 12-inch LF / 1.4-inch exit HF compression driver, 60° x 60° rotatable waveguide, 8-ohm nominal, 600W continuous passive power handling, black finish, with manufacturer's U-bracket and rigging hardware. (Qty: 5 ea.)

Rigging hardware: Steel framing channel (Unistrut P1000 or approved equal, galvanized or black finish), beam clamps, threaded rod, forged shoulder eyebolts, shackles, and galvanized aircraft cable safeties, in quantities required for a complete installation. (Qty: as required)

POWER AMPLIFIERS

Each power amplifier shall have input connections which are either screw-type barrier strip, Phoenix-type, or XLR-type. Networked amplifiers shall incorporate RJ-45 data jacks for network connectivity. Output connections shall be barrier strip or Phoenix-type. Other types of connectors shall not be accepted.

Provide one (1) amplifier channel for each loudspeaker home run, and size each channel for the total load of each circuit. Install the units in equipment rack ER1, and connect as indicated on the drawings.

Provide the manufacturer's Q-SYS plugin for control and monitoring of the amplifiers from within the Q-SYS design.

Furnish and install the following, or approved equal:

8-channel networked amplifier (AMP1, AMP2): Powersoft Ottocanali 12K4 DSP+D, 2RU, eight (8) channels, 1000W per channel at 2 ohms / 1500W per channel at 4 ohms, with onboard DSP and Dante / AES67. AMP1 Channels 1-5 shall drive Rows 1-5 East; AMP2 Channels 1-5 shall drive Rows 1-5 West.

Channels 6-8 of each amplifier shall remain as spare. Refer to Article 1.8 regarding discontinued products. (Qty: 2 ea.)

WIRELESS MICROPHONE SYSTEMS

Digital UHF wireless microphone systems with true diversity reception shall be used in this facility.

The operating frequency band shall be selected so as to avoid interference and shall be legal for unlicensed operation in the United States at the time of installation.

The Installer shall perform a wireless frequency scan at the site in order to determine the proper frequency selection, and shall submit the frequency coordination plan.

The receiver shall be provided with a rackmount kit and installed in equipment rack ER1. Coordinate rack location with the Consultant.

Each system shall be provided on a different frequency so that all can be used simultaneously.

Furnish and install the following wireless systems and accessories, or approved equal:

Shure ULXD4Q quad-channel digital wireless receiver with Dante, frequency band per the RF scan. (Qty: 1 ea.; at ER1)

Shure ULXD2/SM58 digital wireless handheld transmitter with SM58 cardioid dynamic microphone capsule, matching frequency band. (Qty: 1 ea.; HH1)

Shure ULXD1 digital wireless bodypack transmitter, matching frequency band. (Qty: 1 ea.; BP1)

DPA 4088 CORE directional headset microphone, terminated TA4F for compatibility with the Shure ULXD1 bodypack transmitter. Verify color selection with the Owner prior to procurement. (Qty: 1 ea.)

Shure UA874 active directional antenna, wideband version covering the selected frequency band, mounted flush to wall at 10'-0" A.F.F. with 90° tube and tube extension mounting per detail 1 of drawing EAV8.01, connected to the receiver with 50-ohm coaxial cable. (Qty: 2 ea.; AN-1, AN-2)

Shure SB900C lithium-ion rechargeable batteries, and one (1) Shure SBC800 8-bay battery charger with power supply. (Qty: 4 ea. batteries; 1 ea. charger)

AUDIO PLAYBACK AND WALL PLATE INPUT DEVICES

Furnish audio devices for use in source origination and interfacing throughout the sound reinforcement system. Connect as indicated on the drawings.

Furnish and install the following, or approved equal:

Playback device (PB1): Tascam CD-400U 1RU rackmount CD / SD / USB / Bluetooth / AM-FM player with balanced XLR outputs. Connect balanced left and right outputs to DSP1 Line Inputs 1 and 2. Provide AM/FM antennas as required for reception. (Qty: 1 ea.)

Wall plate encoder (BT-1 through BT-4): Visionary Solutions PacketAV DuetE5-WP-C-BT wall plate encoder with HDMI, USB-C (DisplayPort Alt Mode), and Bluetooth 5.0 inputs, Dante / AES67 audio, IEEE 802.3af PoE, 2-gang Decora-style plate, recessed at 1'-6" A.F.F. per drawing EAV4.04. Configure Dante audio output for routing to DSP1. Coordinate plate color with the Architect. (Qty: 4 ea.; BT-1 IDF Corridor, BT-2 North Wall, BT-3 West Wall, BT-4 South Wall)

All required cables, connectors, line amplifiers, attenuators, and splitters for proper operation. (Qty: as required)

CONTROL SYSTEM

These system components and associated programming shall be used for comprehensive control of the AV Systems. Final control panel layouts (GUIs) shall be approved by the Owner and Consultant and shall be part of the control submittal process.

Control panels shall be located as shown. All touch panels shall run user control interfaces hosted on DSP1; no separate control processor is required.

Control panel graphical user interfaces shall, at a minimum, provide: system power on/off; source selection; master and individual source volume and mute; individual wireless microphone gain and mute; playback transport control for PB1; preset recall; and system status / fault indication. All GUIs shall be submitted to the Consultant for approval prior to programming and finalization.

Configure the Q-SYS UCI Viewer application on the furnished iPad for wireless control over the AV wireless LAN, and on any additional Owner-furnished iOS / iPadOS devices designated by the Owner. Provide a password-protected interface for wireless devices. Enroll the iPad in the Owner's mobile device management (MDM) system where required by the Tomball ISD Technology Department.

All associated programming source code and design files for the control systems shall be delivered to the Owner for system backup and future modification purposes. This code is the property of the Owner.

System configuration and programming shall be performed by a QSC Q-SYS Control certified programmer.

Furnish and install the following, or approved equal:

Touch control panel: QSC TSC-101-G3 10.1-inch PoE touch screen controller. TP-1 shall be recessed in a 2-gang box centered at 4'-0" A.F.F. at the IDF Corridor, per drawing EAV4.04, with the manufacturer's wall-mount kit. TP-2 shall be mounted on the custom 4RU rack plate at ER1. Confirm landscape or portrait orientation with the Consultant prior to rough-in. (Qty: 2 ea.; TP-1, TP-2)

Wireless control tablet: Apple 13-inch iPad Air, Wi-Fi, 128GB, Space Gray, current model at time of procurement, furnished under this Section (Division 27). Configure with the Q-SYS UCI Viewer application, connected to the AV wireless LAN. (Qty: 1 ea.; iPAD, shown on drawing EAV9.01)

AV NETWORK

Furnish, install, and configure a dedicated AV network for Q-LAN, Dante audio, control, and AV wireless LAN traffic, with network switch SW1 at ER1 as the hub, as shown on drawing EAV9.01.

Configure VLANs for Q-LAN / Dante audio, control, wireless AV LAN, and management. Configure QoS (DSCP) and PTP per Audinate and QSC guidelines. Enable IGMP snooping and querier as required. Coordinate IP addressing, management access, wireless security, and any hand-off to the District network with the Tomball ISD Technology Department.

Verify that the total PoE load of all connected devices does not exceed the switch PoE budget, with not less than 20% spare capacity, and submit the calculation.

Furnish and install the following, or approved equal:

Managed network switch (SW1): Netgear AV Line M4250 GSM4230P-100NAS, 1RU, 24 x 1G PoE+ ports with 300W PoE budget, 4 x 1G SFP ports, 2 x 1G RJ-45 ports, with AV port profiles and IGMP Plus. (Qty: 1 ea.)

Wireless access point (AP-1, AP-2): Ubiquiti UniFi U7-LR Wi-Fi 7 long-range access point, PoE+, recessed / wall-mounted at 12'-0" A.F.F. per the Audiovisual Device Legend, dedicated to the AV LAN.

Adopt and configure using the UniFi Network application; coordinate the application host with the Owner. (Qty: 2 ea.; AP-1 IDF Corridor, AP-2 West Wall)

Category 6 patch panel at ER1, where field device cabling is terminated on a patch panel per Paragraph 2.2.I.3, with labeling kit. Install in a blank rack space coordinated with the Consultant; no patch panel is shown on drawing EAV7.01. (Qty: as required)

PART 3 - EXECUTION

INSTALLATION

Furnish components, racks, wire, cabinetry, connectors, materials, parts, equipment, and labor necessary for the complete installation of the systems, in full accordance with the recommendations of the equipment manufacturers and the requirements of the drawings and specifications.

Installation shall follow standard broadcast wiring and installation practice, and shall meet or exceed industry standards for such work, with particular attention given to any installation instructions in Part 2 of this Section.

Equipment shall be held firmly in place with proper types of mounting hardware. All equipment affixed to the building structure must be self-supporting with a safety factor of at least three (3), and all overhead suspended loudspeakers with a safety factor of at least five (5). All equipment shall be installed so as to provide reasonable safety to the operator. Supply adequate ventilation for all enclosed equipment items which produce heat.

Furnish the system to facilitate expansion and servicing using modular, solid-state components. All equipment shall be designed and rated for continuous operation and shall be UL listed, or manufactured to UL standards.

Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to ensure that constant polarity is maintained. Balanced audio connectors shall be wired as follows:

Wire	Connector	Signal
Black	Pin #3 or Ring	Low or Negative
Red or White	Pin #2 or Tip	High or Positive
Bare	Pin #1 or Shield	Ground

Provide all audio circuits balanced and floating, except as noted in this Section or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the inputs of the various equipment items in the system.

Route cables and wiring within equipment racks according to function, separating wires of different signal levels (microphone level, line level, amplifier output, 120VAC, network, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with hook-and-loop cable ties. Cables and wires shall be continuous lengths without splices.

All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No unterminated wire ends will be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.

All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. Loudspeaker parallel connections shall be made only at the loudspeaker terminals or at accessible boxes using approved mechanical connectors.

All solder joints and terminations shall be made with rosin-core solder.

Temperature-regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature-unregulated irons shall be used on the job site.

Mechanical connections shall be made using approved connectors of the correct size and type for the connection. Wire nuts will not be accepted.

Each mechanical connector shall be attached using the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting crimping tools are unacceptable and shall not be used on the job site.

Label all wires in racks as to destination and purpose. Clearly and permanently label all jacks, controls, and connections, at the front and back of the rack, with permanent engraved laminated plastic labels or by engraving and filling mounting plates, unless otherwise noted. Embossed or printed label tape, and press-on or lift-off lettering systems will not be accepted on faceplates. All labeling shall be completed prior to final system inspection.

Use insulated bushings to connect conduit to the equipment rack, to insulate conduit ground from the equipment rack ground system.

Certify all Category 6 permanent links with a Level III or better field tester. Extended distance cable runs shall be tested for wiremap, length, and DC resistance per the cable manufacturer's extended-distance test procedure, and shall be verified to link at 1 Gbps with PoE delivered at the connected device. Include results in the final documentation.

Configure the AV network per the approved network design submittal and verify Q-LAN, Dante, and wireless AV LAN operation prior to scheduling commissioning.

Install wireless microphone antennas with clear line of sight to the Indoor MAC Field performance area, and route antenna cable in conduit to ER1 as shown on drawing EAV0.03.

SOUND SYSTEM FINAL TESTING AND EQUALIZATION

The completed sound system shall be physically inspected by the Consultant to assure that all equipment is installed in a neat and professional manner, and in accordance with this Section. The sound reinforcement system shall be equalized by the Consultant, Technical Design Group, Kyle, Texas. Contact TDG at 512-422-5156 at least four (4) weeks in advance of requested check-out dates.

The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site two (2) competent technicians who are familiar with the project, and who will be prepared to stay as long as their services are needed. It is estimated that approximately two (2) days will be required for commissioning of all items in the AV scope of work.

The process of equalizing and testing the system may necessitate moving and re-aiming certain loudspeakers. Provide a powered lift capable of reaching the loudspeaker suspension height for the duration of testing and equalization. Adjustments shall be performed without claim for additional payment.

Coordinate as necessary to ensure a quiet room, with HVAC operating in its normal occupied mode, during the sound system testing and balancing period.

Prior to requesting systems testing, verify the following:

All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published specifications of the equipment, hum, RF interference, or instability of any form.

All specified equipment is on the job site for proper accounting.

All loudspeaker circuits have been tested and are in perfect working order. Furnish impedance measurements of each circuit electronically prior to final tests.

All equipment controls are labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control as to its function with write-on tape.

Operation manuals for every equipment item furnished are on hand at the job site.

The Installer shall provide all signal processing and configuration software loaded on a portable PC and ready for use at the time of testing.

Fire alarm mute and power sequencing functions have been tested and are operating.

Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration shall be arranged at the Installer's expense.

Final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be generated by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

SOUND SYSTEM PERFORMANCE

After equalization and testing, the sound system shall meet or exceed the following specifications:

System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.

Indoor MAC Field F101, measured at 5'-0" above the field surface: 90 dB SPL continuous program level without distortion; spatial variation of +/- 4 dB in the 2 kHz octave band across the field; frequency response of +/- 4 dB from 100 Hz to 8 kHz.

Speech intelligibility: Speech Transmission Index (STIPA) of 0.50 or greater across the field area with the building in its finished, unoccupied condition.

OWNER TRAINING AND FAMILIARIZATION

The Installer shall furnish the Owner's representatives with training necessary to properly operate the systems. Demonstrate in detail all functions of the systems. Provide a minimum of eight (8) hours of instruction and familiarization for this purpose, in sessions scheduled at the Owner's convenience. The training phase shall be accompanied by complete as-built documentation and the custom Technical Systems Operations Manual, as described in Article 1.11. These training sessions shall be video recorded by the Installer and copies provided to the Owner with the as-built documentation.

The Installer shall have a qualified representative, familiar with the system, available to assist in operation at the first Owner event in the facility following final acceptance, selected by the Owner.

END OF SECTION 27 41 00

SECTION 27 41 16 – INTEGRATED AUDIO-VIDEO SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. All Division 26 as it relates to this scope of work

1.3 DESCRIPTION

A. Summary of Work:
   1. Provide a complete and tested video projection system. The Video projection system shall include:
      a. Provide and install all cable and components designated on the project drawings and within this specification section to furnish a complete infrastructure for Interactive Wall Mounted Projectors, Non-Interactive wall mounted projectors and ceiling mounted projectors. Projectors are OFOI.
      b. Provide audio/video input (AVI) and output (AVO) plates at locations indicated on the drawings. Provide all associated cabling, terminations, and pathways required to support future device connections and equipment integration.
      c. Provide and install displays (LCD) at locations indicated on the drawings. Provide network cabling, terminations, and pathways required to support future device connections. LCD's are OFOI.
   2. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
   3. The location of a Projector or PS on the plans indicates a full system including, Projector, PS outlet and sound system for the indicated room.
   4. Reference project drawings for locations, quantities, and coordination with other trades.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. The contractor providing and installing the projector systems and associated infrastructure shall be an authorized dealer of the specified projector manufacturer and be capable of providing the manufacturer's maximum available product warranty.
   2. All individuals installing the audio-video system must be employees of the authorized dealer and at least 75% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
   3. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing audio-video contractor will be allowed for any portion of the audio-video scope of work.

4. The Projector System Installer shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The bidder shall be a firm normally employed in the audio-video industry and shall provide a reference list of ten (10) projects of equivalent size or larger and contact names confirming successful completion of projection system installations.
5. The bidder shall have an authorized service center within 75 miles of the project's location for the brand of equipment that is submitted for bid. The owner reserves the right to perform an on-site inspection.
6. The bidder must produce a letter from the manufacturer guaranteeing the delivery of all the equipment outlined in the specification herein.
7. The bidder shall have a full time local service personnel capable of servicing the projector system described herein.

B. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with individuals deemed necessary by the Owner's representative prior to the start of the work.
2. The contractor shall provide a mock-up of the complete projector system and the interactive whiteboard infrastructure. Both mock ups shall include all products listed in part 2 of this specification. Coordinate with GC, Architect, Engineer, and Owner for scheduling and location of classroom mockup.
   a. All proposing contractors must have ability to demonstrate a/v system being proposed and provide owner with completely installed system to evaluate performance and operation.

C. Acceptance:
1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

D. Warranty:
1. The selected system installer shall be factory authorized service center and shall provide an end-to-end performance warranty of not less than one (1) year. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that video projection system projectors have been tested to the district's approval. This end-to-end warranty shall cover the labor associated with removing/reinstalling any associated hardware or equipment as well as the replacement of all defective equipment or hardware.
2. The bidder shall also submit with the materials mentioned in section 1.5 submittals of this specification a written explanation outlining the terms and conditions of product warranty of all parts and service of the video projection system.

1.5 REGULATORY REQUIREMENTS

A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Latest Local Codes and Amendments
2. 2015 National Electrical Code

B. Other References:
1. TIA/EIA-568-A Commercial Building Telecommunications Wiring Standard
2. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
3. TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial

Buildings.
4. TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. EIA/TIA 455-A Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
6. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
7. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
8. ISO/IEC 1180 Generic Cabling Standard
9. EN 50173 Generic Cabling Standards for Customer Premises
10. ANSI/EIA/TIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

C. Governing Codes and Conflicts:
1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.6 ABBREVIATIONS

A. The following abbreviations are used in this document:
AVI Presentation Station
AVO Audio/Video output
LCD Flat panel screen/monitor

1.7 SUBMITTALS

A. Project Initiation:
1. Within fourteen (14) days of Notice to Proceed, the projection system installer shall furnish the following in a single consolidated submittal:
a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
b. Product Literature: Complete manufacturer's product literature for all LCD monitors, projectors, mounts, projector bracket, speakers, amplifiers, cable, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
d. Testing: Proposed Contractor test result forms, and a list of instrumentation to be used for systems testing.
e. The contractor shall provide a letter from the manufacturer stating that the dealer is an authorized service center.
f. The resume and contact information of the full time service personnel responsible for the installed projection system.

g. Specification Compliance: A letter shall be provided stating, by section and subsection, that the installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

h. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.
   1) The installing contractor shall be an authorized dealer and installer of the specified equipment prior to Bid.

i. The contractor shall provide a schedule of unit pricing for the following:
   1.) Replacement bulb
   2.) Installed cost for each of the products listed in Part 2 of this specification to be used as pricing for any add or replacement of a part of the system the district may deem necessary during the construction or maintenance periods.

B. Shop Drawings:
   1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
      a. Proposed wiring and connectivity diagram of the proposed projection system including all faceplates and sound reinforcing equipment
      b. In addition to the wiring/connectivity diagram, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
         1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
         2) Location of sleeved wall pass-thru
         3) Size of sleeve at each location installed
         4) Quantity of cable passing through each sleeve
         5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
         6) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
      c. Drawing Compliance: A letter shall be provided stating that the installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter.
         No deviations shall be acceptable until they have been accepted by the project's technology consultant.

C. Project Completion:
   1. As a condition for project acceptance, the Contractor shall submit the following for review and approval:

a. Samples: Complete manufacturer's product literature and samples (if requested) for all pre-approved substitutions to the recommended products made during the course of the Project.
b. Inspection and Test Reports: During the course of the project, the Contractor shall maintain an adequate inspection system to insure that the materials supplied and the work performed conform to Contract requirements. The contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
c. Operating and Maintenance Instructions: Operating and maintenance instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner for their use in a three-ring binder labeled with the project name and description (4 copies).

PART 2 – PRODUCTS

2.1 GENERAL

ALL PRODUCTS LISTED IN THIS SECTION SHALL BE PROVIDED AND INSTALLED BY THE CONTRACTOR.

A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.

B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.

C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor.

D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
CM Communications Cable
CMP Plenum Rated Communications Cable
CMR Riser-Rated Communications Cable

E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
1. Approved Products
a. Twisted-pair cable: Dyna-Blue
American Polywater

G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
   1. Approved Products
      a. 3M or
      b. Pre-approved equal

2.2 VIDEO DISPLAYS

A. Projectors, LCD panels, and mounts provided by Owner. The mounts shall be installed by Contractor. The displays shall be installed by the Owner.

B. The Contractor shall notify the Owner at 90 days prior to the time when the mounts are to be installed to allow the Owner to procure the mounts without having to store them. Upon arrival, the mounts shall immediately delivered to the Contractor for installation.

2.3 CABLE ROUTING/PATHWAY

A. Cable Support System: All audio-video cabling shall be installed and supported using a modular cable support system at 4'-0" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.

B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

2.6 AUDIO-VIDEO SYSTEM PATCH CABLES AND CUSTOM PANELS

A. Presentation Station (AVI) wall plate
   1. Double gang, HDMI pass through with USB A pass through connector and 3.5mm pass through connector on stainless steel plate. Custom by ProCo Sound.
      a. Contractor shall provide one of each patch cables for each 'AVI' outlet. Install in wall for connectivity to the LCD or AVO.
         i. 50ft HDMI Active Optical Cable cable, plenum, #C2G41484
         ii. 50ft USB active extension cable, plenum, C2G Part # 39935

B. LCD and AVO Patch Cables
   1. Provide (1) single gang decora brush plate at each LCD location, Leviton # 41075-DBW.
   2. Contractor shall provide one of each patch cables for each 'LCD' and 'AVO' outlet unless noted otherwise:
      a. 2 meter USB 2.0 A/A Cable, C2G # 28106

C. User Connectivity Patch Cables:
   1. Contractor shall provide one of each patch cables, or equivalent, for each 'AVI' outlet
      a. 15ft USB 2.0 A/A Cable, Grainger # 5XF27
      b. 15ft HDMI cable, C2G #29680
      c. 15ft 3.5mm stereo audio cable, C2G #40106

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor is required to properly mount projector and connect all ceiling video/audio cables to projector component inputs.

B. Contractor is required to thoroughly test and verify operation of all projector inputs and video modes prior to project completion.

C. Contractor is required to focus and adjust projector to properly project image on viewing surface (screen or multimedia board depending on location).

D. Contractor shall provide owner with written verification test process and results once all projectors have been installed, tested, and placed in final condition.

E. Damage:
1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).

F. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.

G. Clean Up:
1. All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

A. Contractor shall provide owner with detailed serial number listing and associated graphical room number designation equipment was installed. Contractor shall use actual graphical package room numbers not architectural plan numbers from construction set.

3.3 STATION WIRING INSTALLATION

A. General:
1. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of all category cable. There shall never be more than one and one-quarter inch of unsheathed enhanced Category UTP cable at either the wiring USB Transmitter or Receiver.

B. Exposed Cable:
1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings. Additional exposed cable runs will require Owner approval, and will only be allowed when no other options exist.

C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner’s efficient use of their full capacity.

D. Cable Routes:
1. All cabling placed in ceiling areas must be in conduit, cable tray or PANDUIT® Corp. J-MOD™ modular cable support. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable

through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed.

2. Attaching cable to pipes or other mechanical items is not permitted. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling. Grid support wires. Cable runs shall be routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to insure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install audio-video cabling.

3.4 CABLE

A. GENERAL

1. **Single system cables may be grouped together in a common conduit or cable support of adequate capacity to facilitate the ease of installation and prevent conductor or insulation damage.**
2. Do not group conductors or cables of different systems in one common conduit or cable supports.
3. Install cables as recommended by the system manufacturer. Conductor quantities specified are minimum required. Conductors to be installed shall be coordinated with the system equipment supplier. Cables installed on exposed surfaces, in inaccessible locations, or underground shall be in conduit.
4. Cables installed above accessible ceiling spaces, may be installed without conduit. All cables not installed in conduit shall be plenum rated. Install cables that are not available with a plenum rating in conduit.
5. Cables installed in hollow wall spaces shall be installed in conduit to an accessible location.
6. Tag each circuit at each end and at each terminal with a separate tag indicating area served.
7. Color code wire in accordance with IPCEA standards.
8. Terminate speaker cables in junction box.
9. **ALL LOCAL SOUND DISTRIBUTION SYSTEM CABLE ON THE ENTIRE PROJECT SHALL BE GREY IN COLOR.**

B. Coordinate final connection of power and ground wiring to equipment racks. Power and ground wiring shall terminate inside equipment racks, and be hard wired directly to ground busses to ensure uninterrupted operation.

C. Take precautions as necessary to prevent and guard against electromagnetic and electrostatic noise interference.

D. Exercise care in wiring to avoid damage to the cables and to the equipment. Isolate cables carrying signals at different levels and separate to restrict channel bleed-through the feedback oscillation in any amplifier section. Connect all loud speakers electrically in phase, using the same wire color code for speaker wiring throughout the project. Make all joints and connections with resin core solder or with approved mechanical connectors. Install three conductor individually wired ground 120 VAC stripline in each rack.

E. Keep wiring separated into four groups of conduit for microphone level circuits (level below -20dBm), line level circuits (up to +30dBm), loud speaker circuits (above +30 dBm), and power circuits.

F. Unless otherwise noted, provide the following cable types (or equivalent) for each application:
   1. West Penn 454 #22 AWG twisted pair / shielded for Microphone and Line level signals.
   2. West Penn C210 #10 AWG twisted pair for subwoofer / low frequency speakers.

3. West Penn 227 #12 AWG twisted pair for conventional, full range sound reinforcement speakers.
4. West Penn 226 #14 AWG twisted pair for 70v sound reinforcement speakers.
5. West Penn 810 RG-8 coax cable for RF signal lines.
6. West Penn 4246 CAT6 cable for Local Sound/Video Network.
7. West Penn 4246F CAT6 F/UTP cable for Digital Video.
8. West Penn 841 RG-6 75 ohm cable for Assistive Listening system where required.
9. Extron XTP DTP 24 shielded twisted pair.
10. Provide plenum rated cable where required.

G. Cables, wiring, and interconnect terminal strips to be logically, legibly, and indelibly labeled for immediate identification by a direct hot-stamp method or a factory stamped closed sleeve method as approved. Adhesive strip labels are acceptable only if sealed with transparent heat-shrinkable tubing to hold the marker in its position. Provide all wiring labeling information on schematic diagram in project record drawings. Labeling equal to Brady PM-1M “Porta Mark”, T&B heatshrink markers, or approved equal.

3.5 STATION HARDWARE

A. Flush mounted components: all component shall be inserted to a flush mounted faceplate unless designated otherwise.

B. Placement: Where possible, the ‘PS’ outlets shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches. The CMP outlet shall route directly to the rear of the projector and does not require any type of faceplates, except for the associated USB extender receiver outlet, which shall be installed at 18” A.F.F. in the center of the projection wall. The ‘WMP’ outlet does not require a faceplate and should be mounted 4” off center of the interactive whiteboard location and at +50” above the finished floor.

3.6 FINAL TESTING REQUIREMENTS

A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.

B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor’s use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

END OF SECTION 27 41 16

SECTION 27 51 23 – INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

A. 26 05 00 – Grounding and Bonding
B. 26 05 29 – Electrical Hangers and Supports
C. 26 05 33 – Raceway and Boxes

1.3 APPROVED MANUFACTURERS

A. Carehawk Safety Communications Systems

1.4 GENERAL REQUIREMENTS

A. The intent of this specification is to provide a complete and properly operating, distributed, digital telephonic communications system for the pick-up, amplification, distribution and reproduction of voice and/or other audio program material and time keeping functions. The system shall be of modular design to facilitate both expansion and service and shall be completely solid state. All necessary hook-up and testing shall be by a factory approved representative.

B. The system assemblies shall be completely factory built and tested by manufacturers of established reputation, who have and can refer to similar systems which are currently installed and functioning properly. The factory pre-assembled cabinets, consoles, and power supplies shall be UL approved and listed.

C. The system shall be guaranteed for a period of five (5) years from the date of acceptance or first beneficial use, whichever is first, against defects in materials, workmanship, design and improper adjustment. Any defects in the system shall be corrected at no expense to the Owner, provided the system does not show signs of abuse. During the guarantee period any work found not to be in conformance with the plans, specifications and addenda shall be brought into conformity with same at no additional cost to the owner.

D. The equipment described herein, and furnished per these specifications shall be supplied and installed by one communications contractor. The contractor shall hold the necessary License for this type of work. All reference to model numbers and other detailed descriptive data is intended to establish standards of design, performance, and quality as required. Contractor is required to submit current certification from manufacturer with submittals.

E. The communications contractor shall furnish all equipment, accessories and material required for the installation of a comprehensive Intercom / Telephone / Clock Communications System in strict compliance with these specifications and applicable contract drawings. Any material and/or equipment not specified or described herein necessary for the proper operation of the system shall be deemed part of this specification.

F. The contractor shall instruct personnel designated by the owner in the proper use, basic

care, and maintenance of the equipment. Such training shall be provided as an integral component of the system.

G. The intercom contractor is responsible for all data cabling connections from MDF/IDF headend closets to intercom headend equipment. Coordinate with project data contractor on cabling routing and termination connection points. All data cabling connections to campus network shall be performed by project data contractor who is certified to install network data cabling per Owner's data cabling certification requirements.

1.2 CONTRACTOR QUALIFICATIONS

A. The installing contractor shall be the authorized representative of the intercom system to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the intercom manufacturer's product for at least five years.

B. The contractor shall make available, and maintain a 24 hour, 365 days per year dispatched mobile service department capable of furnishing equipment inspection and timely service at the owner's location.

C. The contractor shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.

D. **The installing contractor must have a permanent office within a 75 mile radius of the project site and be an approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.**

E. The system shall be supplied by the manufacturer's authorized contractor. Certification shall be submitted verifying that the contractor is the manufacturer's authorized contractor. Included shall be certificates of attendance in manufacturer's installation / maintenance training by the contractors directly employed personnel. The communications contracting company shall have been in business for a minimum of 5 years, continuously furnishing the specified manufacturers' product lines and systems.

F. All individuals installing the intercom system must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.

G. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing intercom system contractor will be allowed for any portion of the fire alarm system scope of work.

H. The contractor shall submit certificates of factory authorization and completion of the manufacturer's installation and maintenance training.

I. Acceptable manufacturers:

1. The system specified shall be that of Carehawk Safety Communications Systems
2. No other manufacturers will be accepted.

1.5 SUBMITTALS

A. Provide submittals in as follows:
1. Shop drawings: Provide wiring diagrams clearly indicating proposed equipment and

interconnection of all internal and external components. Include dimensional details of all mounting including rack elevations and ergonomic layouts. Submit to architect for approval prior to fabrication.

2. In addition to the above listed items, the submitted drawings shall show the following:
   a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
   b. Location of sleeved wall pass-thru
   c. Size of sleeve at each location installed
   d. Quantity of cable passing through each sleeve
3. Provide complete catalog cuts of all major components including but not limited to:
   a. Intercom / Telephone / Clock Equipment Racks and Equipment.
   b. Administrative and Staff Telephone Stations, Station Controls and Displays.
   c. Classroom and Station Equipment, Jacks, and terminations
   d. Classroom and Hallway "Amplified Voice" Speakers, Outside Paging Speakers Back boxes and Specialty Rough-Ins
   e. Wire, Cable, Jacks and Termination fields
4. Provide an AUTOCAD engineering floor plan diagram, in 11 inches X 17 inches size format, of the system installation details indicating wiring lay-out, proposed wire routing, rough-in and installation information.
5. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
6. Drawing Compliance: A letter shall be provided stating that the intercom system installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

B. **Certifications/Licensing: The contractor shall submit all of the following certifications/licensing and the all must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.**

1. State Licenses as applicable to this system
2. Manufacturer's Authorized Dealer Certification
3. Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)

1.6 OPERATIONS AND MAINTENANCE MANUALS

A. Provide 3 complete bound O&M manuals describing maintenance and operation of the system. Include descriptions and service data on all component parts. Manual shall also include the following:
   1. Warranty Statement indicating effective dates.
   2. Complete engineering data on all systems furnished including schematics of all equipment, shop drawings on all specially fabricated items, wiring diagrams of the system in its "as built" condition.
   3. Instructions on operational procedures, including master and substation operation,

standard and special codes and alarm or maintenance indications and procedures.

4. A listing of all stations connected to the system, the power drawn by each speaker circuit, and the total load in watts connected to the amplifiers.
5. All system programming information and forms.

1.7 SCOPE

A. Provide a complete and comprehensive distributed, multi-channel, micro-processor School Communications / Clock system. The system shall incorporate integrated Speaker Intercom and fully non-blocking Digital Telephone systems with connection to outside telephone lines as specified. All system functions shall be enabled by DTMF/microprocessor control. The communications system shall be provided by one supplier to assure smooth coordination of all communications needs. The system shall have the capabilities of processing voice/data transmission at the standard ISDN basic rate interface (BRI).to and from any administrative telephone station. The system shall accept direct DS-1 level interfaces.

B. If an existing system is indicated, on the project drawings, to be reused; the contractor shall provide and install all applicable equipment and material required to accommodate the existing and new devices shown. It shall be the responsibility of the installing contractor to verify that the existing panel meets or exceeds the specifications below, including, but not limited to the approved manufacturer.

1.7 FUNCTION - INTERCOM

A. GENERAL: The system shall provide the state of the art in distributed technology and include but not limited to; priority based access to voice functions, emergency call-in, covert PC based call-in, pre-recorded emergency announcements, external and internal telephone access, integrated video surveillance, secondary clock corrections, bell schedule and optional district wide communications functions. The system shall contain RS232, RS485, USB, and Ethernet ports for communication to third party systems. The system shall be easy to learn and operate using windows based software. All standard system programming shall be user friendly to allow the system administrator the ability to easily program system features both locally and from remote locations.

B. Provide complete and satisfactorily operating Integrated Intercom/Communications System as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturer’s standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

1.8 FUNCTION - MASTER CLOCK:

A. Provide an internal master clock with the following features:

1. Non-volatile memory capacity for storing unlimited schedules with unlimited events on each schedule. Ability to review, edit and delete events. Fully automatic calendar execution capable of future event programming to 30 years. Automatic Daylight Savings Time change with leap year programming. Interface with Dukane, Sapling, Rauland, National Time and Signal, American Time and Signal, Simplex and Latham secondary clocks whether synchronous wired or electronic.

2. The master clock shall be capable of being synchronized by a Network Time Server (NTP).

3. Provide for scheduling of tone events, output events, program source events and video camera events.

4. Secondary clocks for elementary schools shall be single or double faced, analog, corrective, 12” round display according to floor plan, unless noted otherwise. Secondary clocks for high schools shall be 4 inch digital LED clocks single or double faced according to floor plan. Provide protective guards in high activity areas and gymnasiums.

5. Provide semi-flush back boxes for all single face clocks.

6. Clock power supply: provide secondary clock power supply. Power supply shall be sized in quantity to meet the load requirements of the system.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Furnish and install a microprocessor-controlled voice, telephone, communications and clock system with all conduit, wire, outlets, and equipment as shown on the drawings and as herein specified to provide a complete sound, program distribution, and voice intercommunications system in the building.

B. DA1
   a. Furnish and install the required administrative telephones (DA1) with all conduit, wire, outlets, and equipment as shown on the drawings. Contractor shall provide (1) DA1 at the Receptionist, Assistant Principal Office, Principal Secretary Office and Principal Office.

C. CTEL
   a. Furnish and install the required Caller ID telephones (CTEL) with all conduit, wire, outlets, and equipment as shown on the drawings.
   b. General—For the purposes of this specification, a Caller ID capable telephone that is connected to the **CareHawk CH1000LT** System through the Analog Telephone Interface (VFS16/32) shall be referred to as a CTEL. A CTEL is a standard off the shelf display telephone that can be wired or wireless. Various types can be intermixed throughout the system. They may or may not include a speaker phone feature. Note that system audio quality/intelligibility is dependent on these telephones.

D. STEL
   a. Furnish and install the required single line telephones (STEL) with all conduit, wire, outlets, and equipment as shown on the drawings.

1. SYSTEM OPERATION

   A. The **CareHawk CH1000LT** is a Life Safety Communications System, multichannel, microprocessor-controlled communications system. The system is capable of distribution using Administration telephones (DA1s), IP telephones, standard DTMF telephones (STELs), Caller ID Telephones (CTELs), loudspeakers, and other devices as described herein. The system central equipment shall be capable of receiving 2048 call-ins simultaneously without

data collisions or loss of any call-ins. Call-ins shall remain in the system queue until answered. Emergency Call-ins shall automatically move to the top of the call-in queue and sound in the in-use telephone earpiece to notify the user of an emergency call. The system shall provide two independent intercom channels between any telephone and loudspeakers. Two additional, simultaneously operating channels shall be provided for distribution of program material. Systems not providing multiple, simultaneous speech paths/voice channels shall be unacceptable.

a. The system shall provide user-programmable room number assignment.
b. The system shall provide 3-, 4-, 5- or 6-digit alphanumeric format for architectural room numbering and 60 character alphanumeric call ID description associated with each audio port.
c. The dialing sequence shall incorporate full numeric capabilities as available on industry-standard telephone key pad.
d. The DA1 and CTEL shall allow the user to view the numeric room address of the calling station and the type of call (e.g., emergency, normal). The DA1 shall use distinctive ringing patterns to annunciate the type of call. The CTEL shall be capable of being programmed to visually annunciate the call type. It shall be possible for some CTELs to display the date and time.
e. When a CTEL is employed as part of the CH1000LT System:
f. Emergency and normal call-ins and telephone calls shall be routed to the VoIP Telephone Module (VTM) or the Central Control Card (CC200) for processing and shall be sorted in order of priority as well as time of call placed.
g. The CTEL shall be used to view call-ins, access the system, and perform many of the functions available from the DA1 at a touch of a button. Some of these functions are emergency paging, tone distribution, music distribution, and intercom.
h. Calls from STELs or intercom call-ins shall display in the same manner.
i. CTELs shall allow the user to respond to the call and view call information for both telephone and intercom calls. Calls from call-in devices shall be capable of being programmed to call into CTELs. These phones shall ring when called.
j. The base system shall support eight FXS Caller-ID enabled telephone ports. FXS ports shall be used to interface with system Administrative phones, standard telephones, and PBX/KSU/.iPBX/VoIP telephone systems. The system shall have the capability to add additional ports in groups of I6 or 32 Administration or standard telephones and any number of IP telephones.
k. The system shall allow future expansion of the program channels to a total of two individual channels.
l. The system shall be compatible with industry-standard 2500 DTMF telephone instruments with electronic ringers (STELs) and CTELs.
m. The system shall not require an Administrative console to operate. All system functions shall be accessible via telephone codes from any internal and/or external telephone.
n. The system shall be capable of providing individual control of inputs from and outputs to external devices.

B. Rooms shall be equipped with programmable call-in buttons, STEL handsets or IP telephones. Call-ins can additionally be initiated by operation of a personal wireless transmitter, Vcall PC base call button or security sensor. Call-ins from buttons shall be programmed to a minimum of seven priority levels. Upon arrival at the designated DA1 or CTEL, the call shall be visually displayed and audibly

annunciated. Audible and visual annunciation shall also be received at a remote display unit (RDU) if the system is so equipped. The system shall be capable of accepting up to three call-in devices, each with different priorities.

C. The system shall have the capability for modular capacities of 2048 audio ports including speakers and Call in buttons. The system shall support any number of DA1s, CTELs, STELs, IP telephones, Inputs, and outputs.
    a. All port locations shall be assigned to a 3-, 4-, 5- or 6-digit full numeric/alphanumeric dial number as available on industry-standard telephone key pad.
    b. Systems that are not modular or expandable or require replacement of any previously installed equipment shall not be acceptable.
    c. The system shall support a minimum of 8 trunk ports.

D. Provide, if desired by Owner, a unique pre-announce tone to sound prior to the normal class change signal or as desired for unique events. These tones are WAV files and can be adjusted for level and duration, as desired.
    a. The system shall provide for a minimum of 25 distinct WAV file system tones and 25 custom WAV files, each of which shall be programmed from a selection of tone types.
    b. The following programmable system tone events shall be available:
        a. Emergency page pre-announce
        b. Civil emergency
        c. Auxiliary alarm
        d. Emergency reminder tone
        e. Page pre-announce
        f. Normal reminder tone
        g. Custodial tone
        h. Door tone
        i. Intercom pre-announce
        j. Privacy tone

E. The system shall provide up to two simultaneously operating, non-restrictive, multiple input source, program distribution channels. This functionality shall be programmed and distributed from DA1s, CTELs, STELs or IP telephones. The system shall provide restriction of programming channels from all or certain designated telephones. Systems that require manually operated switchbanks shall not be acceptable.

F. The system shall have user-assignable groups of stations for zoned audio paging, class change signals, or program distribution, with any station belonging to all zones, some zones, or no zone.
    a. Paging shall originate from any DA1, CTEL, STEL, PBX, IP telephone, dedicated paging microphone, or program source input.
    b. The system shall allow a telephone to be associated directly with a loudspeaker by assigning them the same dial number.
    c. The system shall include page or intercom priority over class change tones and preprogrammed events. Class change tones occurring simultaneously with an all page or zone page shall be programmable to be delayed until the active page has concluded.
    d. The system shall use the industry-standard 25-volt method of transmission. Systems using non-standard methods such as 45-ohm loudspeakers without line matching transformers shall not be acceptable.
    e. The system shall allow each loudspeaker to be a member of up to 64 zones.
    f. Communications with each classroom loudspeaker shall be hands-free. The staff member or occupant in the classroom need not operate any buttons to reply to a call. The DA1 operator shall use the hands free option or handset on the DA1.
    g. A mute button shall be provided on the DA1 to allow the operator to mute the outgoing conversation as desired.

G. All audio functions in the system shall operate within the following priority scheme:
    a. A lower priority function shall not interrupt a higher priority event.
    b. A lower priority event shall be interrupted by a higher priority event.
    c. Interrupted lower priority functions (automatic) shall be restored after conclusion of the higher priority function. If an event is initiated while a page is occurring, the event shall be optionally delayed until the page is complete.
    d. Telephone conversations shall not be interrupted by the above listed functions.
    e. The following priorities are ranked from highest to lowest;
        a. Emergency intercom
        b. Emergency page
        c. Civil emergency
        d. Manual time tone and high priority event tone
        e. All call and zone page
        f. Intercom
        g. Custodial tone
        h. Low priority event tone
        i. Program distribution

H. In rooms provided with a privacy switch, the system shall incorporate all necessary circuitry to prevent overhearing conversations in any room equipped with a loudspeaker. The DA1 shall provide the user with an indication that the classroom privacy switch is in the privacy mode.

I. The system shall distinguish between an emergency call and a normal call from any station, and automatically route each type of call-in to a different DA1, CTEL, STEL or IP telephone.
    a. The system shall also include provisions to allow call-in coverage to be redirected to an assigned coverage group manually, or if the call-in is not answered within a user-defined period of time.

J. Each call-in switch shall be programmable or assignable to one of seven priority levels and up to 32 distinct call-in destination groups. The seven priority levels shall be as follows:
    a. Priorities shall be assignable to any one of three levels of emergency calls:
        a. Emergency–1 (E1)
        b. Emergency–2 (E2)
        c. Emergency–3 (E3)

    b. Priorities shall be assignable to any one of three levels of normal calls. A normal call shall be remotely upgraded to an emergency call (E1) by pressing the call button twice.
        a. High priority (HP)
        b. Normal priority (NP)
        c. Low priority (LP)

K. Normal and emergency priority levels shall provide a distinctive call-in ring with a programmable cadence.

L. Calls routed to the appropriate DA1, CTEL, STEL or IP telephone destination group's call-in queue shall be placed in the order of priority and time of origination. When a call-in occurs to a specific call destination group, the call-in shall ring at all DA1s, CTELs, STELs and IP telephone in the assigned group. Any telephone within the group shall be able to answer the call. Telephones not within the call group can also answer using a dial code. When a call-in is not answered within a user-designated programmable time and the call-in shall be re-directed to other call groups. The call-in then shall be answered at any DA1, CTEL, STEL or IP telephone by dial code.

M. Calls routed to the DA1 shall display the incoming caller's room number and caller-ID information along with the total number of calls within the call-in queue. Calls can be scrolled by the DA1 using the "Down" key or the "UP" key for selective answering of intercom calls. If the DA1's queue has a high priority or emergency call-in present (Priorities E1–E3), a calling telephone shall receive a busy signal. Emergency calls received at the DA1 shall cause the calling station identification number to be accented in the display. Normal calls shall be displayed steadily.

N. When a system port is dialed from the DA1, the dialed number shall appear in the DA1 display window. Ring back or tones from the DA1 shall indicate the mode of operation currently activated.

O. Calls routed to the CTEL shall display the incoming caller's room number and caller-Id information after first ring cadence. Normal and emergency calls received at the CTEL shall be displayed steadily. Depending upon the type of CTEL employed, the date and time of call shall also be displayed. A Type 2

CTEL already off-hook during second pending call, shall display pending call after a call waiting signal.

P. When a system port is dialed from the CTEL, the dialed number shall appear in the CTEL display window. Ring back or tones from the CTEL shall indicate the mode of operation currently activated.

Q. DA1, CTEL, STEL and IP telephone calls to other telephones shall ring the appropriate telephone and be connected when the called party goes off-hook.

R. The system shall allow any system telephone to be programmed to place an off-hook duress call-in to any destination groups. Duress call: A preprogrammed destination group and priority level can be programmed to occur after a preprogrammed off-hook time limit.

S. The system shall allow any telephone to place an emergency voice paging announcement. (This can be restricted to individual telephones through page access restrictions.)

T. The STEL shall also be used to initiate a tone, WAV file or a local program to rooms, zones, or all rooms.

U. The STEL shall be configurable to initiate a normal or emergency priority level voice page to zones, or intercom to a speaker, or dial another telephone automatically when off-hook.

V. The system shall provide the capability for a loudspeaker station, handset, and zero to three call-in devices at each remote location or classroom.
    a. When an STEL is located in the classroom, the user shall have the ability to toggle back and forth between conversing on the telephone or the speaker station.
    b. If a call is placed to a classroom loudspeaker, the call is automatically transferred to the handset when the handset is lifted. This is a user-programmable option on a telephone by telephone basis.
    c. In a room equipped with a loudspeaker, if the handset is off-hook and a call is placed to that room via the loudspeaker, the caller’s voice shall be automatically received in the room. This allows the caller to contact an individual room and carry on two-way communications even though the telephone is off-hook. Two separate and distinct voice paths are available to each classroom.
    d. Call-in devices shall consist of single or multiple switch assemblies, with or without privacy switch capabilities, and with or without call assurance LED capabilities.

W. The system shall allow any telephone to be programmed to allow or exclude initiation of all call, zone page, or emergency announcements.
    a. The system shall allow any preprogrammed telephone parameter to be circumvented through the use of a pre-assigned account code. Upon hanging up, the telephone returns to its previously programmed state. Up to 256 account codes are available allowing for staff and administrative programming override. Account codes shall be controlled by both day and night Class of Service in addition to 8 different Event Class of Service Groups.
    b. The system shall support a minimum of 64 different Class of Service parameters with each extension having both day and night class Class of Service. The following attributes are programmable and available for each Class of Service:
        a. Dial access
        b. Telephone ring access
        c. Direct off-hook call-in answer
        d. Timed off-hook duress call-in
        e. Page access
        f. Tone access
        g. Program access
        h. Intercom access
        i. Room exclusion access
        j. Output control access
        k. Forward access
        l. Administrative access
        m. Digit 9 access
        n. Digit 8x access
        o. Direct off-hook intercom speaker-to-handset transfer
        p. Emergency ring access
        q. Normal ring access
        r. Direct off-hook page or telephone call
        s. Direct off-hook intercom answer

X. The DA1s, CTELs, STELs and IP telephones shall be capable of, but not restricted to, the following:
    a. Two simultaneous, three-party conference circuits
    b. Extension-to-extension direct dialing
    c. Extension-to-speaker station direct dialing
    d. Call on hold
    e. Call transfer
    f. Paging
    g. Tone distribution
    h. Preprogrammed speed dialing
    i. Call forwarding
    j. Interface with electronic key system and/or PBX

Y. A group of loudspeakers shall be temporarily excluded from receiving time, non-emergency page, or program distribution by designating the desired stations as excluded stations from a preprogrammed zone.
    a. Using the Dukane Assistant Software, individual rooms desiring exclusion on a temporary basis, (e.g., student testing purposes or quiet times) shall be able to exclude themselves for the day. The initiator can cancel this exclusion at any time. A temporary exclusion shall programmed with the CareHawk Calendar Software to automatically

return to the preprogrammed station status before the start of class the next day.

b. The system shall allow that a group of loudspeakers be permanently excluded.

Z. The system shall contain a flexible database capable of addressing each system telephone and assigning unique parameters to each phone.
   a. Each classroom telephone shall be capable of being associated (for answer purposes) with specific administrative telephones. This association can be automatically changed dependent upon time of day.
   b. Each classroom telephone shall be assigned an architectural or ID number to communicate with its assigned administrative telephone. This coverage shall allow preselected coverage of call-ins from classroom telephones to administrative telephones, on a station-by-station or room-by-room basis.
   c. Call-ins to administrative telephones shall be programmed to call groups of administrative telephones.

AA. The system shall contain an integral master clock and programmer capable of performing the following functions:
   a. Provide unlimited discrete time event entries for programming functions based upon:
      a. The time of day in hours and minutes
      b. The day or combination of seven days of the week on which the event is to occur
      c. The selection of any one or any combination of 64 zones or five internal outputs to be activated
      d. The selection of any schedule to allow for maximum flexibility due to special circumstances or seasonal changes
      e. The selection of 25 user-programmable event tones plus 25 WAV files.
   b. Provide for automatic daylight saving time adjustment with leap year programming.
   c. Provide momentary contact closures for external device operation. Provide six inputs, five outputs, and two flex-puts.
      a. Inputs shall be programmable by the installer/system administrator to initiate any desired system activity (e.g., tone, program, events).
      b. Outputs shall be programmable by the installer/system administrator to activate during any desired system activity (e.g., page, tone, program, time of day).

   d. Display the time of day in either 12 or 24 hour format at each administrative telephone.
   e. The master clock shall interface with an existing master clock to allow the two systems to synchronize.
   f. The master clock shall correct compatible secondary clocks, analog or digital or both.
   g. The system shall provide for an editing and review routine to permit the user to change and edit time events, zones, and schedules.
   h. The system shall allow preselected program material to be distributed according to preprogrammed schedules (i.e., march to music, national anthem.)

BB. The system shall include facilities to allow automatic control of external devices, (e.g., cameras.) The system shall provide multiple outputs designed to interface with external devices. A total of 133 outputs shall be provided. Outputs to activate/deactivate remote door locks or operate cameras shall be activated manually from an DA1, CTEL, STEL or IP telephone. Refer to the section covering input and output control for additional capabilities.

CC. The system Central Control Card (CC200) shall contain a minimum of 1 Gigabytes of removable/upgradable flash storage and 512 Megabytes of RAM. Minimum processor speed shall be 500 MHz to efficiently process the time critical events generated by the CH1000LT communications platform. The processor shall control all functions and features of the built-in self-diagnostics and continually monitor the system's integrity. All system programs and changes shall be permanently stored on the Central Control Card (CC200). It shall be possible to review and reload any program or change that was loaded on the system regardless of age. The system shall be provided with a user-friendly PC interface, Windows® based, for system programming and diagnostics. User or service technicians shall send or receive complete system configuration data, using system software packages. All system programming shall be stored on the Central Control Card (CC200). The system shall allow this information to be reloaded at any time either on-site or from a remote location. The software shall support remote (off-site) diagnostics and system programming through an Ethernet connection.

DD. The system shall filter all voice signals through a Digital Signal Processor (DSP) to maximize voice intelligibility.

2. ADMINISTRATIVE TELEPHONE (DA1)

A. The DA1 shall be desk or wall mounted and contain a matching telephone handset with retractable coiled cord and conductive rubber button switches, with clearly designated touch points. The housing shall be constructed of high impact, flame retardant, black plastic. Dimensions shall be 9-1/2" (23.75 cm) wide by 4-1/2" (11.25 cm) high and 8-3/4" (21.9 cm) deep. Dimensions include handset. Weight shall be 4 lb. (1.8 kg). Terminations shall be a RJ-45 modular telephone type jack. Features shall include:
   a. Plastic moisture-sealed buttons
   b. Large, easy-to-read, 8 line by 20 character back lit display
   c. Menu-driven display for ease-of-operation
   d. Handset or speakerphone
   e. Alphanumeric 3-, 4-, 5- or 6-digit dialing
   f. Distinctive electronic ring signals
   g. 200 speed dials
   h. Wizard driven menu system
   i. User-programmable function keys
   j. Telephone-type modular connector
   k. Sensitive loudspeaker
   l. Built-in condenser microphone
   m. Queuing
   n. Telephone-style handset with dynamic receiver and electret transmitter
   o. Head set compatible

B. EQUIPMENT ENCLOSURES: The Intercom Program Equipment shall be wall mounted. The overall equipment cabinet dimensions shall not exceed 18 ½ "H x 17"W x 5-3/8"D. Color shall be black. All intercom system / program equipment shall be provided as required to fully implement a functioning system. The equipment enclosure will include the Central Control Card, Main Interface Card, Power Supply Module, Intercom Modules, Telephone Communication Modules and Digital Amplifier.
   a. The system shall be mounted on 3/4” plywood backboard (painted)
   b. The program sources shall be remotely located from the control equipment. The program rack shall be a black metal finish, tabletop rack located at the reception area. Do not provide wood finish cabinet.
   c. Provide CAT5 connections for 8 telephone ports and 8 local or remote Switching Security Modules (SS16/32).
   d. Provide wall mounted remote Security Switching Modules as required mounted in IDF Rooms.

C. SPEAKERS, CEILING MOUNTED: Shall be 8" full range loudspeaker baffle combination. 5 oz. nominal magnet eight, 10 watt continuous power, with matching dual 25/70 volt transformer. Transformer shall be capable of delivering at least 5 separate wattage taps from 1/4 watt to 4 watts. Flush mounted onto steel back box. Provide Dukane 6A634 or approved equal. Provide Dukane 145-226 enclosure system and Dukane 677-67speaker supports for each speaker. All speakers in the following room types shall have volume control on the speaker to allow for adjustments: Classrooms, Admin, Reception, Conference Rooms, Kitchen and staff work areas

D. Cafetorium, General Purpose Rooms etc. with architectural lay-in ceilings 12 feet above finished floor or greater shall have 8” speaker with 5 oz. magnet complete with line matching transformer. Program rating shall be 12 watts continuous. The speaker shall be Atlas Sound AT-SD72WV or approved equal. Provide Atlas Sound model number #AT-SD72WV enclosure system and 81-8R speaker

supports for each speaker. 25/75 volt transformers shall have primary taps of ½, 1, 2, 4 watts.

E. CLOCKS: 12 inches 24 VAC synchronous analog clocks for elementary schools or 4 inch LED digital for high schools. Provide Dukane as shown on plans. Provide backboxes, wiring, and raceway as required for proper operation. Provide wire guards in cafeteria/gym.

F. WALL MOUNTED SPEAKERS: 8 inches full range speakers with dual 25/70 volt transformer shall mount in flush square speaker baffles as shown on the plans. Soundolier C5A speaker with LT72 transformer 161-8 square baffle, and 198-8 flush square enclosure. If speaker must be surface mounted, provide SE175-4 enclosure.

G. Outdoor paging speakers shall be on a separate zone from interior speakers. Each individual room such as a classroom, office, conference room, or gymnasium shall be a circuit.

H. WALL MOUNTED VOLUME CONTROL Provide as shown on floor plans. Provide Soundolier AT-10 or approved equal recessed autotransformer volume control. Routine paging shall not override the volume control.

I. OUTDOOR WEATHERPROOF PAGING / PROGRAM SPEAKERS: Shall be UL listed, flush mounted water proof type paging speakers for voice and tones with matching transformer. Quantity as shown on plans. Provide Soundolier APF-15T With 193-8-6 Back box and VP161-APF Baffle. Back boxes shall be recessed to allow horn to be flush mounted with wall.

J. AM - FM ANTENNA: Provide a complete AM/FM antenna system, as required for proper radio reception. Provide a weather headed conduit run from roof to intercom junction box if required. Provide all mounting and connection hardware to receive available off air channels. Feed from building cable system, provided under separate section is an acceptable signal source. Installation shall be in accordance with latest safety standards. All masting and outdoor mountings shall be capable of with standing winds of up to 100 MPH. Provide lightning protection and grounding as per National Electrical Codes. To minimize likelihood of a lightning strike, contractor shall mount the antenna so that its upper tip is below the metal flashing at the edge of the roof.

K. SURGE PROTECTOR / UPS: Provide a Minuteman, rack mounted EnterprisePlus Line Interactive Uninterruptible Power Supply, Model #E1500RM2U

L. Program Source
   a. Provide Tascam CD-400U - CD/SD/USB Player with Bluetooth® receiver and FM/AM tuner
   b. Provide Outdoor Antenna – Coordinate location during construction
   c. Provide Proco iPod input panel
   d. Provide Black table top enclosure for all equipment
   e. Provide 4 push buttons to activate 4 distinct tones

2.2 ADDITIONAL EQUIPMENT

A. Contractor shall include in their pricing, the cost to furnish and install the following additional equipment. These devices shall be used to fulfill any changes request issued until the list is depleted. Upon the completion of the project, all remaining material shall be delivered to the project for owner stock. No devices shall be used without documentation and written authorization from the project's technology consultant. Contractor shall obtain a signed transmittal of additional equipment to the owner at the end of the project. The signed transmittal shall be included in the contractors closeout documents.

B. Additional Equipment List:
1. (15) Ceiling Mounted Speakers with tile bridges
2. (15) Wall Mounted Volume Controls
3. (2) Administrative Call Stations
4. (5) Exterior Speakers
5. Provide (1) concealed remote button to activate lockdown tone while simultaneously calling 911.
6. Provide network capability to allow for remote programming.

PART 3 – EXECUTION:

3.1 MATERIALS:

A. WIRE: Wire between the main equipment cabinet and local or remote Security Switching Modules shall be CAT5 with wire distances not exceeding 2700 feet. Cable for speakers, call-in switches, and security inputs shall be #22 gauge at a minimum or as recommended by the manufacturer under plenum jacket. No splices are permitted except in approved junction boxes. All terminations shall be made on telephone type punch blocks or at specified devices. Display, speaker, and specialty cables shall be as required for best operation under manufacturer recommendations.

B. JACKS: All station device terminations (except speakers) shall be terminated on USOC standard modular jacks. Jacks for wall mounted telephones shall have lugs for securely attaching the instrument to the wall.

C. BACKBOARDS: Provide 4 feet x 4 feet plywood backboards for mounting of system cross connects. Mount as shown on the plans. Provide Modular Termination backboards with 66 type terminal blocks as required to terminate all cables. Provide Distribution and cross connect backboards equal to AT&T 66 Series for all cross connect wiring.

D. Cabling between the Security Switching Modules and the terminal blocks shall be provided with telephone type 50 pin connectors to allow ease in console connections, disconnection's and service. SDA1lite terminal junction boxes shall be provided as needed to allow for station terminations in each building.

3.2 INSTALLATION:

A. All work under this section shall be performed by persons having specific familiarity with telephone, data and sound system installation. Upon request the contractor shall submit resumes, references or other corroborating documentation, to the engineer to confirm the contractors capabilities and experience.

B. GROUNDING: Except were specifically indicated otherwise, all exposed non-current carrying metallic parts of the communications system shall be grounded. This may be accomplished via a driven ground rod, cold water pipe or building power ground. If the

building power ground is used, a separate ground conductor shall be used from the equipment to the grounding grid. All grounding shall be done with #6 solid copper wire or larger. The contractor shall use every effort to insure system stability and safety.

C. WIRING: A comprehensive, documented communications wiring system is to be installed. Wiring is to be identified by room number, segregated, neatly laced, and terminated on telephone type punch blocks. Back boards and cross connect fields shall be neatly organized as to function. (ie: intercom, telephone stations, data network etc.) All termination points are to be labeled with function. Data cables shall be certified as usable and checked using the cable certification sheet. Data cables shall be labeled as per the data identification scheme.

D. SPEAKER WATTAGE TAPS: Tap Corridor Speakers for 1 watt, Outside Horns 7.5 watts, Tap Speakers in High Ceilings (15FT +) at 4 watts. Rest rooms ½ watt.

E. All communication wires and cables installed above ceiling shall be identified and tagged at each end. The identification shall include the room number one markers similar to T&B sleeve marker.

F. Provide integration with clock and bell system

G. Provide integration of local sound reinforcement system override.

H. Mount all handsets on 2-gang electrical boxes at 42” a.f.f. unless noted otherwise.

I. Mount outdoor paging speaker in flush mounted box with 15 watt power rating and with built-in matching transformer. Attach firmly to building and provide water tight fit.

J. Provide for future portable buildings. Provide 12 circuits minimum, pulled and punched down on terminal block above the ceiling at the exterior wall where portables will be located.

K. All headend equipment and wiring shall be provided and installed for future circuits on initial installation.

L. Speakers in very small or very reflective rooms (ex. Restrooms) shall be tapped at ¼ watt.

M. All communication wiring between the main equipment cabinet and the Security Switching Modules shall be CAT5. Wiring to speakers, call-in switches and security inputs shall be 22 AWG, Type TW and all audio signal wiring shall be # 16 except where indicated otherwise or as required by article 800 of NFPA 70 (NEC).

N. Final system room designations shall be based on actual room number graphics (Do not use the construction plan Architectural room number designations).

3.3 CABLE PATHWAYS

A. Cable Support:

1. All wire not installed inside conduit shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.

1. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5’ of the finished ceiling, the contractor shall provide a dedicated threaded rod extending

within 5’ of the finished ceiling and mount the support hook to the treaded rod.

2. Cable support shall be installed at a maximum of 5’ on center.
3. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
4. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING’S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
5. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**

B. Conduit / Raceway:

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC, local, and state requirements.
3. Minimum conduit size shall be 3/4" (19.1 mm). Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

3.4 TESTING AND ACCEPTANCE

A. General

1. After completion of installation and start up procedures, commence a verification and testing sequence leading to final acceptance of the owner.
2. Submit for approval, a sample of the form on which the test will be reported.
   a. Identify project
   b. Signatures of participants and observers
   c. Results
   d. Description of adjustment or corrections of defective components.
   e. Date
3. Provide schedule of tests. Estimate dates of significant events.
   a. All testing shall be performed in the presence of the Owner/Architect/Engineer.
4. Test, calibrate and adjust each device in the system
5. Verify operation of all specified functions.
6. Provide documentation of all tests and verifications as specified.

B. The following tests and adjustments shall be performed by the Contractor. All equipment required supplied by the Contractor. Follow EIA standards RS-160 and RS-219 in performing tests. Mall all necessary corrections to bring systems into specification

compliance. Record the results of these tests in project record drawings. Submit written results of tests to Architect prior to scheduled equalization and final inspection date.

1. Measure and record impedance of each speaker line terminating at equipment racks at frequency of 1,000 Hz. with loud speakers connected to their respective lines.
2. Check system to ensure freedom from oscillations or stray RF pickup. Check inputs with no signal and with typical program material driving system to full output. Detect unwanted signals.

3.5 INSTRUCTIONS

A. Provide 4 hours, of instruction to the Owner designated user and maintenance personnel on the use and operation of the system. Instructing personnel shall be a competent engineer or technician familiar with the installed system. Instruction times shall be arranged by the Owner.

3.6 ACCEPTANCE BY OWNER

A. Upon completion of initial tests and delivery of all documents, diagrams, and project record drawings, notify the Architect in writing that the installation has been completed in accordance with the requirements of the specification and is ready for equalization and inspection by representatives of the Owner.

B. Acceptance testing will include operation by the Owner of each major system and other components (microphones, consoles, racks, loud speakers, etc.) deemed necessary. Contractor will assist as necessary in this testing.

C. In the event the need for further adjustments or work becomes evident during acceptance testing, the Contractor will continue his work until the system is acceptable, at no additional cost to the Owner.

3.7 TESTING AND TRAINING:

A. Prior to connection of any terminal equipment all cables shall be tested as per REA spec. PC-4. Cables shall be tested for Opens, Splits, Crossed Pairs, Shorts to Ground and Shield Continuity. All defective cabling is to be replaced prior to device hook-up.

B. Upon completion of the installation the contractor shall test each room station speaker, handset or call switch for proper operation. All telephones, programming and functions are to be tested for proper operation. All emergency and program functions are to be tested. Any malfunction shall be corrected prior to final acceptance.

C. A minimum of Four hours time shall be included in the bid for instruction of the owners forces in proper operation and routine maintenance of the system. Instruction shall cover all materials indicated in the owners and operations manual.

D. Operational guidelines shall be given in written form in sufficient numbers so that all key personal have operational instructions of programming, station use and special features. Copies of these instructions shall be provided for permanent record in the operations and maintenance manuals specified in DIVISION 1.

END OF SECTION 27 51 23

SECTION 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

PART 1 – GENERAL

1.1 WORK INCLUDES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.

B. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the Electronic Safety Systems as shown on the drawings and as specified herein.

C. Coordinate wireway, raceway, power, and outlet requirements with the builder and the electrical contractor.

D. Cable pathways, conduit, boxes and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.

E. The Electronic Safety Systems Contractor shall provide and install prior to cable installation plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.

F. Supply in a timely manner to the electrical contractor special backboxes for installation as required.

G. It is the intent of the Contract Documents to provide complete installations although every item necessary may not be specifically mentioned or shown.

H. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.

I. Provide line-by-line specification review for each Division 28 section annotated to certify compliance or deviation.

1.2 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

A. Provide utility services conduit as outlined on drawings as required.

B. All required conduit for accessibility to attic space.

C. Furnishing and installation of all required standard back boxes and conduit.

D. Installation of special back boxes supplied by Division 28 contractor(s).

E. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.

F. Provide equipment-mounting boards as outlined on drawings.

G. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.

H. Provide 120-volt power and hook-up to equipment provided in Division 28.

I. Coordination of requirements of Division 28 with the Builder.

1.3 WORK NOT INCLUDED

A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection, purchase, or installation of interconnect instruments/equipment to be used on this project.

1.4 RELATED SECTIONS

A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.

B. Section 26 05 34 - Provisions For Communication, Security & Safety Systems.

1.5 CODES, STANDARDS, AND THEIR ABBREVIATIONS

A. General:
   1. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
   2. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
      a. OSHA Safety and Health Regulations for Construction.
      b. NFPA No. 70 National Electrical Code.
      c. NESC National Electrical Safety Code, ANSI Standard C2.
      d. NEiS National Electrical Installation Standards.
      e. Local Codes and Ordinances.

B. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.

C. Materials and components shall be UL listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.

D. The Contractor shall obtain all permits required to commence work. Upon completion of the Work, the Contractor shall obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters, the City of Little Elm, Texas, and other authorities having jurisdiction. The Contractor shall pay required permit fees.

1.6 LIST OF ASSOCIATIONS AND STANDARDS:

ADA:	Americans with Disabilities Act.
ANSI:	American National Standards Institute, 1430 Broadway; New York, NY 10018.
ASTM:	American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
BICSI:	(RCDD5 Standards), 8610 Hidden River Parkway, Tampa, FL 33637
CBM:	Certified Ballast Manufacturers Association, 2116 Keith Building; Cleveland, Ohio 44115.
IEEE:	Institute of Electrical and Electronics Engineers, 345 East 47th Street; New York, NY 10017.
ICEA:	Insulated Cable Engineers Association, P.O. Box P, South Yarmouth, MA 02664.
NEC:	National Electrical Code; NFPA No. 70.

NECA: National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.; Washington, DC 20014.
NEMA: National Electrical Manufacturers Association, 155 East 44th Street; New York, NY 10017.
NESC: National Electrical Safety Code, ANSI Standard C2.
NFPA: National Fire Protection Association, 60 Batterymarch Street; Boston, MA 02110.
OSHA: Occupational Safety and Health Administration, US Department of Labor; Washington, DC 20402.
TAS: Texas Accessibility Standards (TAS) Article 9102.
UL: Underwriters Laboratories, Inc., 333 Pfigsten Road; Northbrook, IL 60062.

A. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.

B. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.

C. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.

D. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.

E. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.7 DEFINITIONS

A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.

B. The Builder: The primary contractor engaged to oversee the construction project. They may be technically described as a Construction Manager, General Contractor, Managing Construction Contractor, et cetera.

C. The Contractor: The Contractor engaged to execute the work included a particular section only, although he may be technically described as a Subcontractor to the Builder. If the Contractor, engaged to execute said work, employs Sub-Contractors to perform various portions of the work included under a particular Section, they shall be held responsible for the execution of this work, in full conformity with Contract Document requirements. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various sections and phases of work may be properly coordinated without unnecessary delays or damage.

D. The Electrical Contractor: The Electrical Contractor shall be engaged to execute the work included Division 26 only.

E. PDF file or .pdf: The filename extension associated with “Portable Document Format” files, which are multi-platform computer files in the ISO 32000-1:2008 open standard format developed and licensed by Adobe Systems. These files are a digital electronic representation of text, documents, images, and technical drawings in a font and color-accurate fixed-layout format that is platform and display resolution independent. PDF files can be electronically transmitted, viewed, or printed with various free PDF reader application programs, and may allow markups/comments with various PDF editing application programs.

F. Provide: Defined as requiring both the furnishing and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

1.8 SCHEDULE OF VALUES, APPLICATION FOR PAYMENT

A. The Contractor shall in accordance with the General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, complete a Schedule of Values and Applications for Payment. When a portion of this work separately funded, including donations or E-Rate, the contractor shall accommodate this in the Schedule of Values and Applications for Payment. For E-Rate eligible portions of this work, the contractor will be required to participate in the E-Rate program, comply with all E-Rate regulations, and provide billing as needed. The contractor shall coordinate with the Owner to file Form 471 or latter edition and/or other forms as may be required.

1.9 WARRANTY

A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.

B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.

C. He shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.

D. The Owner shall give notice of observed defects with reasonable promptness.

E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.10 SITE VISIT

A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.

B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.11 SUBMITTALS

A. Submittal procedures shall be per Division 1 - General Requirements.

B. Provide a complete submittal for each section as specified.

C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.

D. A submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.

E. Each Product data submittal shall include:
   1. A cover sheet with the name and location of the project, the name, address, and

telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.

2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
4. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
6. When the contract requires extended product warranties, submit a sample of warranty language.
7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.

F. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.

G. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.12 PROJECT RECORD DOCUMENTS

A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.

B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner revised plans showing "as installed" work.

C. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:

1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
3. Any software programs, data/programming files, passwords, special interface cables, or keys that may be needed to maintain or access equipment.
4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
5. Any and all other data and/or plans required during construction.
6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
   a. Builder and all Contractors.
   b. Major Equipment Suppliers

c. Submit communication systems warranties.

1.13 TRAINING

A. Upon completion of the work and at a time designated by the Architect, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all Electronic Safety Systems equipment and systems.

B. See other sections for time requirements.

1.14 PLANS AND SPECIFICATIONS

A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.

B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.

C. Install the work complete including minor details necessary to perform the function indicated. Provide Electronic Safety Systems (including all hook-ups) complete in every respect and ready to operate.

D. If clarification is needed, consult the Architect/Engineer.

E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.

F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.15 PRODUCT SUBSTITUTIONS:

A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.

B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.

C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.

D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.

E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.

F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.

G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.

H. Requests for substitution are understood to mean that the Contractor:
   1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
   2. Will provide the same guarantee for the substitution that he would for that specified.
   3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
   4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
      a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
      b. The specified product is unavailable through no fault of the Contractor.
      c. The manufacturer refuses to warranty the specified products as required.
      d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
      e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
      f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

1.16 FUTURE USE CABLING

A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.

B. Locations and Existing Conditions:
   1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
   2. The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.17 PROTECTION OF EQUIPMENT AND MATERIALS

A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.

B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.

C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.18 FINAL OBSERVATION

A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final observation.

B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.

C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
   1. Final clean up completed.
   2. All systems are fully operational, all material and devices installed.
   3. As built (as installed) drawings and operations manuals.

1.19 PROHIBITED MATERIALS

A. No new asbestos, lead, or materials containing these substances shall be permitted in this project. The Contractor shall consult the Architect concerning these materials if their presence is suspected. All work in or around existing asbestos or lead materials is at the sole risk of the Contractor and his personnel.

1.20 CUTTING AND PATCHING

A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.

B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.

C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.

D. Patching of openings and/or alterations shall be provided by the Electronic Safety Systems Subcontractor or at the Subcontractor's expense in an approved manner.

E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.

F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.

G. All openings in exterior walls shall be sealed watertight.

H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping

materials and methods in accordance with NFPA and local codes.

1.21 MANUFACTURERS' INSTRUCTIONS

A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.

B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.

C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.22 INSTALLATION

A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.

B. The Electronic Safety Contractor shall coordinate installation of the systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to ensure a complete working system for the Owner.

C. Where required for accessibility all conduit and boxes for all Electronic Safety Systems shall be provided by the Electrical contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.

D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.

E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.

F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.

G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.

H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.23 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

A. All costs to provide 10 additional fire alarm signals including all cable and devices as directed

by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 – PRODUCTS

A. Not Applicable

PART 3 – EXECUTION

A. Not Applicable

END OF SECTION

SECTION 28 13 00 – ACCESS CONTROL SYSTEM

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. This specification section scope of work shall include card reader access interface and all associated wiring at locations shown on the project drawings. Provide and install all materials and devices as designated below.
   1. Card Readers
   2. Wiring from the card reader to the head end location and all door hardware
   3. Connections to electrified door hardware and associated power supplies
   4. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
   5. Access control head end equipment and power supplies shall be included as part of the project base scope of work and should be included in the project's base pricing.

1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

A. National Fire Protection Association Standards:
   1. NFPA 70 National Electric Code
   2. NFPA 72 National Fire Alarm Code
   3. NFPA 101 Life Safety Code

B. Local & State Building Codes

C. Requirements of Local Authorities having Jurisdiction

D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.

E. Requirements of American Disabilities Act (Public law 101-336).

F. Texas Accessibility Standards (T.A.S.)

G. State Fire Marshall.

H. Texas Insurance Code.

1.4 QUALITY ASSURANCE

A. Contractor Qualifications:
   1. The installing contractor shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
   3. The installing contractor shall be licensed by the State of Texas as a security

services contractor to design, sell, install, and service security alarm systems.

4. The installing contractor shall provide 24 hour, 365 day per year emergency service with factory trained service technicians.
5. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
6. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person is allowed to work on the system without proper manufacturer's certification.
7. **Contractor shall provide an access control system built around Open Options platform. Contractor must be authorized to install, configure and support Open Options products and software.**
8. **The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.**

1.5 SUBMITTALS

A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
   1. Riser diagrams.
   2. Complete floor plan drawings locating all system devices.
   3. Factory data sheets on each piece of equipment proposed.
   4. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
   5. Complete system bill of material.
   6. Line by line specification review stating compliance or deviation.

B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 – PRODUCTS

2.1 ACCESS CONTROL PRODUCTS

A. Manufacturers
   1. Manufacturer List
      a. **Open Options**, Inc. 3440 Sojourn Drive Suite 240 Carrolton TX 75006
   2. Product Options
      Software: Open Options: DNA Fusion
      a. Controllers
         1) SSP-D2 Intelligent Controller
      b. Subcontrollers
         1) RSC-2 Dual Reader Subcontroller
      c. Wall Mount Readers
         1) Schlage MT15
      d. Mullion Mount Readers
         1) Schlage MT11
      e. Credentials
         1) Schlage 7610T (FOB)
         2) Provide 200 quantity.
      f. Request to Exit switch shall be installed on the interior of all doors equipped with Card Readers.
         1) Schlage Scan II-W

g. Door Position Sensor
1) Aritech 1076D-G for recessed mounting
2) Aritech 2507AD-L for surface mounting

3. Power Supplies
a. Schlage PS-902, PS-904, PS906
b. Power Supplies to come with Battery Back-up – 900-BBK
c. Power supplies to include 8 Fuse protected outputs – 900-8f

4. Lockdown Button
a. STI #SS2242LD-EN

5. NO SUBSTITUTIONS

B. Description
1. Regulatory Requirements
a. All controllers and sub-controllers will be UL294 listed assemblies.
2. Sustainability Characteristics
a. Provide all licenses and software updates required to operate system.
b. Provide an application server that exceeds the following minimum specifications:
1. Multi-Core Processor speed 2.4 GHz
2. System Memory 4GB
3. 10/100 Ethernet Networking Card
4. Hard Drive(s) with 250 GB storage space
5. VGA support for 1024x768 resolution
6. Video memory 128MB
7. CD/DVD drive with read/write capability
8. Windows Server 2003 or 2008
9. Universal Power Supply (UPS)

c. Provide a database server that exceeds the following minimum specifications:
1. Processor speed 2GHz
2. System memory 2GB
3. 10/100 Ethernet Networking Card
4. Hard drive(s) with 100 GB storage space
5. VGA support for 1024x768 resolution
6. Video Memory 128MB
7. CD/DVD drive with read/write capability
8. Windows Server 2003 or 2008
9. Microsoft SQL Server Standard Edition (2005 or 2008 version)
a. Server/Client Access License (CAL) licensing with one CAL per client machine
b. Provide minimum 5 CALs.
10. Universal Power Supply (UPS)

d. Provide (2) client computers that exceed the following minimum specifications:
1. Multi-Core Processor speed 2.4GHz
2. System Memory 4GB
3. 10/100 Ethernet Networking Card
4. Hard Drive(s) with 250 GB storage space
5. VGA support for 1024x768 resolution
6. Video memory 128MB
7. CD-ROM drive
8. Windows 7 Professional or Ultimate editions
9. Keyboard and Mouse

10. 2 available USB Ports
11. 17 inch Monitor
12. Univeral Power Supply (UPS0

e. Provide (1) camera for capturing photos to print on credentials.
   1) Manufacturer: Video Associates Labs
   2) Model: VALCAM USB Zoom+ 900-628

2.2 WIRING

A. Where required, all access control wiring shall be purple in color and a minimum of 18 AWG on the entire project.
B. Wire scheme and conductor quantity shall be as required by the manufactures specifications. Contractor to provide and install shielded cable as required.
C. All 120v Power shall be furnished by the electrical contractor. In the event that an electrical contractor is not contracted for the project, the system installing contractor shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.
D. All Security Conduit as required for a complete installation of this system shall be furnished by the electrical contractor as part of their scope of work. In the event that an electrical contractor is not contracted for the project, the system installing contractor shall provide and install all conduit required.
E. Coordination with the electrical contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
F. All systems shall be connected to a dedicated circuit and on an emergency power source if available.

PART 3- EXECUTION

3.1 INSTALLATION

A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.

C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.

D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of

conductors traversing the respective box as well as the number of terminations required.

H. Network Connection Cable: Provide a 4 pair Category 6 data cable from the Master Control Panel to the MDF network rack. Category 6 cable shall be purple in color.

I. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.

J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

K. Install system in accordance with manufacturer's instructions.

L. Install wiring for detection and signal circuit conductors in conduit. Use 22 AWG minimum size conductors.

M. Make conduit and wiring connections to existing door hardware devices as required.

3.2 CABLE PATHWAYS

A. Cable Support:
1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
   a. Approved Cable Support Product:
      Modular support system (sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per support size.
2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
3. Cable support shall be installed at a maximum of 5' on center.
4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
5. Absolutely no cable, not installed in conduit, will be allowed to be attached directly to the building's steel or supported in any other method than that stated above.
6. It is the responsibility of the installing contractor to coordinate with all other trades on the project to insure that the pathway of this system does not interfere with the installation of the other trades and to prevent the installed product of other trades from putting strain on the installed wiring.

B. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop

drawings.

4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
5. All conduit ends shall have a protective bushing to prevent cable damage. BUSHINGS MUST BE INSTALLED PRIOR TO INSTALLING CABLE. CUTTING BUSHING TO INSTALL AROUND INSTALLED CABLES WILL NOT BE ACCEPTED.

3.3 WARRANTY

A. All provided and installed infrastructure and devices shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.4 FIELD QUALITY CONTROL

A. Test in accordance with NFPA 72 - National Fire Alarm Code

B. Test in accordance with Hirsch Electronics testing procedures for "Velocity Security Management System".

3.5 TRAINING

A. The two designated System Administrators shall attend the 4 Day Factory Velocity Class.

B. The Contractor shall coordinate with the District’s System Administrators for two 8 hour Operator training sessions on the Operational System to be conducted on-site for the actual running system.

3.6 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services for final system checkout and acceptance testing as required.

3.7 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 28 13 00

SECTION 28 23 00 – CCTV SECURITY CAMERA SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Video Management Systems
    1. Server application.
    2. Desktop application.
B. IP security cameras.
C. Network video recorders.
D. Accessory products.

1.02 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
B. Division 23 – Heating, Ventilating, and Air Conditioning
C. Division 26 – Electrical
D. Division 27 – Communications

1.03 REFERENCES

A. Code of Federal Regulations (CFR).
B. Institute of Electrical and Electronics Engineers (IEEE):
    1. 802.3 Ethernet Standards.
C. International Electrotechnical Commission (IEC).
D. International Organization for Standardization (ISO):
    1. ISO / IEC 10918 - Information technology - Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
    2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
    3. ISO / IEC 23008-2 - High Efficiency Coding And Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part 2 (ITU H.265, HEVC).
E. European Standard (EN):
    1. EN 50121 - Railway Applications. Electromagnetic Compatibility.
    2. EN 50155 - Railway applications - Rolling stock - Electronic equipment.
    3. EN 50130-4 - Alarm Systems. Electromagnetic Compatibility. Product Family Standard: Immunity Requirements For Components Of Fire, Intruder, Hold Up, CCTV, Access Control And Social Alarm Systems.
    4. CE EN 50581 - Technical Documentation For The Assessment Of Electrical And Electronic Products With Respect To The Restriction Of Hazardous Substances.
    5. EN 55022 Class A - Information Technology Equipment - Radio Disturbance Characteristics - Limits And Methods Of Measurement.
    6. EN 61000-3-2-A2 - Electromagnetic Compatibility (EMC) - Part 3-2: Limits - Limits For Harmonic Current Emissions (Equipment Input Current: 16 A Per Phase).
    7. EN 61000-3-3 - Electromagnetic Compatibility (EMC) - Part 3- 3: Limits - Limitation Of Voltage Changes, Voltage Fluctuations And Flicker In Public Low-Voltage Supply Systems, For Equipment With Rated Current less than or equal to 16 A Per Phase And Not Subject To Conditional Connection.
F. European Union Safety Standards (CE).
G. Federal Communications Commission (FCC):
    1. FCC Rules and Regulation of Title 47 of CFR Part 15 Subpart B Class A.
H. Open Network Video Interface Forum (ONVIF):

1. ONVIF - Profiles G, S, T Specification.

I. Underwriters Laboratories (UL):
   1. UL listed.
J. United States Military Standard (MIL-STD):
   1. MIL-STD-810F - Environmental Engineering Considerations and Laboratory Tests.

1.04 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
B. Solution Proposal: System Integrator shall submit the Solution Proposal.
C. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Manufacturer's printed or electronic data sheets.
   2. Manufacturer's installation and operation manuals.
   3. Warranty documentation.
D. Shop Drawings: Include details of construction, interface of equipment, and relationship with adjacent construction.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
B. System Integrator shall provide the following as part of the System Solution:
   1. Complete product and technical data specification sheets that include all material and equipment and shall be available freely online.
   2. List of all equipment with part numbers, manufacturer, firmware, and assigned IP addresses.
   3. Locations and details for all components to be installed under this scope of work.
   4. Placement Diagram showing the proposed location of all system hardware devices.
   5. System Calculation of all network bandwidth and storage requirements for System Servers to ensure proper planning of computing and networking infrastructure.
C. Installer Qualifications: Minimum 2-year experience installing similar products. Installers shall be trained and authorized by the Manufacturer to install, integrate, test, and commission the system.

1.06 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.
   1. End User provides specific details, A/E by specification shall ensure coordination by contractors to establish and schedule meetings for pre-installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.08 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.09 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.010 WARRANTY

A. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Hanwha Techwin, which is located at: 500 Frank W. Burr Blvd.; Teaneck, NJ 07666; 877-213-1222; www.HanwhaSecurity.com

2.02 IP SECURITY CAMERAS

A. Camera Model Selection Guidelines
   1. Brand Selection - All cameras provided to Tomball ISD shall be Hanwha Techwin Wisenet cameras. If a dealer chooses to install another brand of camera at any Tomball ISD facility, the camera(s) shall be replaced, at no cost to the Tomball ISD, by the installing dealer with the following approved Hanwha Techwin Wisenet cameras models.
      a. Substitution Request – Dealer may request to submit alternate Hanwha cameras models to Tomball ISD for review and acceptance (or not) by Security Management. If so, specific model acceptance must be approved by Tomball Security Management prior submitting any quotes.
   2. **Provide cameras by "Type" as shown on the drawings.**

Manufacturer:
HANWHA

CAMERA	DESCRIPTION
Type 1	Hanwha PND-A9081RV (4K IR Indoor Vandal Dome AI Camera)
Type 2	Hanwha PNM-C12083RVD (6MP x 2 AI IR Multi-directional / Vari-Focal)
Type 3	Hanwha PNM-C16013RVQ (4CH mini AI Multi-directional)
Type 4	Hanwha PNM-C32083RVQ (4K x 4CH AI Multi-directional / Vari-Focal)

Type 5	Hanwha PNM-C34404RQPZ (4K 4CH PTRZ + 2MP 40x PTZ AI Camera)
Type 6	Hanwha PNM-C34404RQPZ (4K 4CH PTRZ + 2MP 40x PTZ AI Camera)
Type 6	Hanwha PNO-A9311R (4K AI IR Bullet Camera / Vari-Focal)
Type 7	Hanwha QNV-C8011R (5MP IR Vandal Dome Camera)
Type 8	Hanwha QNV-8080R (5MP IR Vandal Dome Camera)
Type 9	Hanwha QNV-C9011R (8MP IR Vandal Dome Camera)
Type 10	Hanwha QNV-C9083R (8MP IR Vandal Dome Camera / Vari-Focal)

B. Minimum Camera Performance Requirements
   1. Video Compression and Transmission: Cameras shall have the following properties relating to video signals they produce.
      a. Compression: H.265, H.264 and MJPEG. Each derived from a dedicated encoder and capable of being streamed independently and simultaneously.
         1) H.265 and H.264: Maximum of 30 fps at all resolutions
         2) MJPEG: Maximum of 30 fps
      b. Video Stream Profiles: Able to configure 6~10 independent profiles with differing encoding, quality, frame rate, resolution, and bit rate settings.
      c. Video Streams: 10 independent stream types using unicast protocol.
         1) Multicast and unicast video streaming.
      d. DDNS Configurable: At no additional cost by manufacturer.
      e. Smart Codec: Dynamic GOV, and Dynamic FPS to efficiently manage bitrate of video stream.
   2. Camera Physical and Performance Properties:
      a. Impact Protection: IK08~IK10 vandal resistance for indoor cameras
      b. IP66 rating minimum for Outdoor Cameras
      c. Resolution and FPS
         1) 2MP camera imager sensors shall transmit full 1080P resolution (1920x1080) at a 30FPS using all Codecs (H.265/H.264/MJPEG) with no FPS reduction with the implementation of WDR and / or analytics in the camera.
         2) 5MP camera imager sensors shall transmit full 2560x1920 resolution at a 30FPS using all Codecs (H.265/H.264/MJPEG) with no FPS reduction with the implementation of WDR and / or analytics in the camera.
         3) 6MP camera imager sensors shall transmit full 3328x1872 resolution at a 30FPS using all Codecs (H.265/H.264/MJPEG) with no FPS reduction with the implementation of WDR and / or analytics in the camera.
         4) 4K camera imager sensors shall transmit full 3840x2160 resolution at a 30FPS using all Codecs (H.265/H.264/MJPEG) with no FPS reduction with the implementation of WDR and / or analytics in the camera
      d. Configurable privacy masking regions utilizing a 4 point polygon
      e. Camera Models with IR Illumination True day and night operation with removable IR cut filter.
      f. Digital Noise Reduction: 2D and 3D technology.
      g. Cameras for viewing in darkness shall include Integral IR illumination, providing effective visibility of 65.62 ft (20 m) at 0 Lux when activated in black and White mode.
   3. Intelligence and Analytics: A suite of integral intelligent operations and analytic functions to include:
      a. Motion Detection: Eight definable detection areas with 8 point polygonal zones, minimum and maximum object size.
      b. Logical Events Detection from Camera Video Input:
         1) Tampering (scene change).
         2) Defocus detection.
         3) Motion detection with metadata.
         4) Virtual Area Based Event:
            i. Enter or exit.
         5) Virtual Line Based Event:
            i. Directional detection.
            ii. Crossing.
   4. Interoperability: ONVIF Profile S, G and T compliant and SUNAPI API
   5. Camera Characteristics:
      a. Built-in web server, accessed via standard browsers including MS Internet Explorer, Firefox, Chrome and Safari.

b. Dual edge recording slot like Micro SD/SDHC/SDXC memory card with configurable pre-alarm and post- alarm recording intervals.
c. Bi-directional audio.
d. Alarms and Notifications supported:
e. PoE capable.

6. Multi-Sensor Camera Additional Requirements
    a. In addition, all multi-sensor cameras (including Duo (2) Imager Sensors and Quad (4) Imager Sensors) shall also include the following Model: PNM-7002VD/PNM- 9000VD, PNM-9084QZ, PNM-9084RQZ, PNM- 9085RQZ, PNM-9002VQ, PNM-9022V and PNM- 9030V, PNM-9031RV, PNM-9322VQP as manufactured by Hanwha Techwin America.
    b. Each Video Channel shall utilize a dedicated SOC to that Video Channel to process and deliver full frame rate video at 30 FPS using all Compression Codecs (H.265, H.264 and MJPEG), with no degradation or reduction to any individual Video Channel or Collectives Channels when enabling WDR or advanced video analytics.
    c. Each Video Channel shall support individual enablement of intelligent analytics, WDR, and codec selection independent of the remaining video channels.
    d. Each Channel supports SD card.
    e. One single power supply for all multi-channels

C. UPS & ELECTRICAL SURGE PROTECTION
1. All Network Camera to NVR Connections Shall incorporate an appropriate in line network Surge Protection Device when the Network Camera is located on the exterior of a building and connecting network switch / Network Recorder on interior of building.
2. All Critical Operation Network Cameras shall be on a POE Switch attached to a Pure Sine Wave Power Conditioning UPS or UPS circuit that is sized for the specified required operational time. It is recommended that all UPS systems are sized to provide back-up power for a minimum of 20 minutes or owner stated guidance, with 20% growth capacity, to maintain Video System Operation during brief outages or generator activation and power cut over.

2.03 VIDEO MANAGEMENT SYSTEMS (VMS)

A. Video Management System (VMS)
1. Software: Wisenet Wave v4.2 as manufactured by Hanwha Techwin America.
2. System Requirements:
    a. Open video platform designed for use in any video application.
    b. Specified Software: To include, free of charge, any API or SDKs necessary to integrate third party devices and systems.
    c. Specified Video Management Solution's Architecture: To include Desktop, Media Server, Mobile, and Cloud applications.
3. Software Components Characteristics: Four applications working seamlessly together.
    a. Cloud Application: Enables simple remote connectivity, viewing, and management of an unlimited number of systems and users.
    b. Media Server Application: Responsible for discovering, connecting to, and managing system users, devices, and associated data.
    c. Desktop Application: Capable of acting as a stand-alone media player or as a client application for connecting to and managing systems.
    d. Mobile Application: For iOS and Android devices that allows users to connect to, view, search, and control IP cameras over Wi-Fi or Data networks.
4. Built-In Developer and Integration Tools: Accessible from System Server's Web Admin Interface (compatible with all major browsers).
    a. Server API: SUNAPI implementation giving developers the ability to access every system feature available.
    b. API Change Log: List of breaking changes in API from version to version.

c. Video Source Integration SDK: Integrate virtually any live or recorded video source (IP Cameras, NVRs, DVRs, etc.) into the VMS with methods for discovering, displaying, analyzing and recording video, as well as integrating device I/O ports and related motion detection information.

5. System Architecture:
   a. Server Hive Architecture:
      1) System servers are equal synchronizing system databases in real-time.
      2) Users can connect to any system server to see and manage entire system.
      3) Servers support automatic camera failover ensuring limited loss of video recording in event of hardware or network failure.
   b. One-click System Wide Updates:
      1) System Administrators Capabilities:
         i. Upgrade entire system via single button in Desktop Application.
         ii. Upgrade on demand to latest release or specific builds with specific functionality or bug fixes.
   c. Use secure technologies for inter-application communication and security.
      1) Email Server: Client (Mobile, Desktop, Web) Communications - HTTPS Email - TLS / SSL - TLS; default option.
      2) Salted/Hashed Passwords: Local credentials protected using a salted MD5 hash, cloud credentials should use a complex multi-level hash.
   d. The VMS will not require any licenses to increase the number of supported devices, users, or servers.

B. VMS Server Application:
   1. Runs on the Following Operating Systems:
      a. Microsoft:
         1) Windows 10 Professional, Windows 10 IOT Enterprise
         2) Windows Server 2019.
   2. Minimum Compatible Computing Hardware:
      a. Any hardware able to run a compatible operating system.
      b. Capable of recording 128 dual-streaming IP cameras (256 streams) on a single core of an Intel Core i5 processor.
   3. Performance:
      a. Automatically discover, stream, and record any ONVIF Profile S IP camera located on same subnet as server application.
      b. Manually discover, stream, and record RTSP, HTTP, or UDP (multicast, unicast) streams.
      c. Automatic camera failover without any additional licenses.
      d. Unlimited number of users and custom user roles.
      e. User Login Credential Management: LDAP / Active Directory / Open LDAP integration.
      f. Record and Stream
         1) Video: H.264, H.265, and MJPEG.
         2) Audio: AAC, PCM (Mu-Law, A-law), g726, and MP3.
      g. Transcode Streams on Demand: For delivery to 3rd party system devices.
         1) Codecs: H.265, H.264, MJPEG or WebM.
      h. Pass-through high-res or low-res HLS streams from connected devices.
      i. Support Addressing: IPv4 or IPv6.
      j. Operator ability to change size of reserved disk space for storage drives.
      k. Concurrent recording of all connected cameras / streams to two servers in real-time.
      l. Server-side, CPU-based motion analysis for all connected IP cameras with no perceptible increase, less than 3 percent, in CPU usage.

C. VMS Desktop Application:
   1. Runs on the Following Operating Systems:

a. Microsoft:
    1) Windows 10
    2) Windows 10 IOT Enterprise Solutions.
    3) Windows Server 2019
b. Apple / Mac.
    1) OSX 10.12: Sierra.
    2) OSX 10.13: High Sierra.
    3) OSX 10.14: Mojave.

2. Minimum Compatible Computing Hardware:
    a. Any hardware able to run a compatible operating system with a CPU that supports OpenGL 2.1 and Intel HD Graphics 3000 (or higher).
    b. Will not require any dedicated graphics drive to work at full capacity; 64 streams on a 64 bit OS, 24 streams on a 32 bit OS, and use the CPU for all video decoding and rendering.
3. Performance and Basis Structure:
    a. Navigation Panel: Main menu button, an interactive cloud-login icon, tabbed layouts, minimize and maximize icons, a contextual help icon, and a close application icon.
    b. Resource Panel (Left): Contains all system resources (Servers, Devices, Users, Layouts, Offline files, etc.) with collapsible structure and a keyword search mechanism to allow operators to quickly search for a display live streams / cameras, offline video and image files, or any combination thereof.
    c. Notifications Panel (Right): Shows all system or rules- engine generated notifications which can be clicked on to display relevant resource in the viewing grid.
    d. Timeline Panel (Bottom): Allows for navigation and search of recorded video files.
    e. Viewing Grid (Main Viewing Area): A flexible adaptive grid interface which allows operators to create and share customized layouts of system resources.
4. Operation: Allow operators to do the following.
    a. Scroll to and zoom in on any zone of viewing grid.
    b. Drag and drop to reassign cameras from one server to another server.
    c. Via a flexible timeline, view dates of any and all archived video in the System for a specific camera, or groups of cameras.
    d. Manually Create Bookmarks: With start time, end time, name, description, and tags, for later search. Bookmarks must also be able to be created using the Rules engine.
    e. Execute a Smart Motion Search: By selecting a subset of a live camera stream with results shown in red on the flexible timeline. Smart Motion search should be able to search a year (12 months, 365 days) of archived video in less than one second.
    f. Search video archives by date and time with a responsive, adaptive timeline.
    g. View, Search and Export All system events, System bookmarks, System logs and Audit trail of operator actions and replay related video.
    h. Create and share lockable layouts.
    i. Modify and save a shared layout to affect an instantaneous change to that layout on the VMS Desktop application of any user connected to the system viewing that layout (when the system administrator saves the layout the layout will update in real time for any user viewing that layout).
    j. Support two-way audio between operators and supported devices.
    k. Support audio alerts as an action that can be played on users' computers or connected system devices.
    l. Force open an alarm layout triggered by any system or 3rd party event with one or many associated cameras or resources.
    m. Force users to set the camera's initial password upon enrollment for best cyber security practices.

2.04 VMS SOFTWARE LICENSES

A. All new systems shall provide, at minimum, one WAVE VMS license per camera. Additionally, if additional cameras are being added to existing system, dealer shall include one new WAVE license per camera. Following are the acceptable WAVE VMS camera license references.

B. Model: WAVE-PRO-01,-04,-08,-16,-24,-48 as manufactured by Hanwha Techwin America
   1. Description: WAVE camera license, Enables one IP stream recording per "-0x" license(s) purchased.
      a. Purchase sufficient quantity of WAVE licenses as needed to record the number of camera streams being added to a WAVE System
      b. Note: Cameras that used only for Live Patient Room Monitoring and will NOT be recorded, then WAVE licenses for these specific cameras are not necessary. However, proper sizing of the Recording Server is still required to support the cameras.

C. Model: WAVE-VW-02 as manufactured by Hanwha Techwin America.
   1. Description: WAVE, Video Wall License, Enables displaying video on up to two (2) additional monitors with remote control of video displayed on those monitors.

D. Model: WAVE-ENC-04 as manufactured by Hanwha Techwin America
   1. Description: WAVE, 4 Channel Encoder License

E. Model: WAVE-IO-01 as manufactured by Hanwha Techwin America
   1. Description: WAVE, I/O module license, Enables one (1) I/O module

2.05 CLIENT WAVE WORKSTATION

A. Model: WWT-P-7401 WAVE Client Workstation supporting up to Four (4) attached monitors
   1. The Workstation shall have a dedicated operating system drive to facilitate accelerated boot and application load times
      a. OS Drive – 1x 256GBSSD internally mounted with Operating System - Microsoft Windows 10 Pro
   2. Video Storage - support to add additional 3.5" drive with capacity options for 1TB, 2TB, 4TB, 8TB, 10TB, 12TB, or 14TB per drive at Speed of 7200 rpm
   3. Processor: Qty 1 Intel® 9th Generation Core™ Processor, Intel® Core™ i7-9700, 3.0Ghz to 4.7Ghz (8 Cores, 8 Threads, 12MB) and 16 GB DDR4 RAM memory
   4. Graphics Cards - NVIDIA® Quadro® P620 with 4x HDMI adapters
   5. Network Controller 1. Ports: 1 x 1GbE RJ45
   6. Additional Ports - Video output: Varies with GPU, (1) HDMI 2.0b, (1) DisplayPort 1.4 on motherboard, up to (4) DisplayPort 1.4 , USB: Front: (2) USB 3.1, (2) USB 2.0, Rear: (2) USB 3, (2) USB 2.0
   7. Electrical - Power: 100–240 V AC, auto-ranging, Power Supplies: 200W 80 Plus Bronze
   8. Mechanical - Dimensions (w x d x h): 3.7" (97mm) x 11.5" (292mm) x 11.4" (290mm)
   9. Weight: 11.42 pounds (5.14 kg)
   10. Environmental - Operating temperature: 50°F - 95° F (10°C - 35°C)

B. UPS & ELECTRICAL SURGE PROTECTION
   1. All Client Workstations shall be connected to a properly sized Pure Sine Wave Power Conditioning UPS or circuit to prevent voltage fluctuations (increase or decrease) that can affect operation and cause damage to the equipment.

2. All Client Workstations shall be installed on an electrical circuit that incudes protection against transient voltage surges.
3. It is recommended that all UPS systems are sized to provide back-up power for a minimum of 20 minutes or owner stated guidance, with 20% growth capacity, to maintain Video System Operation during brief outages or generator activation and power cut over.

2.06 ACCESSORIES

A. Accessory Products: Provide the following accessories to properly install and mount all cameras as required by the specific camera installation locations, as applicable to the system selected and as scheduled on the Drawings.
   1. Pendant Caps
   2. Corner Mount Brackets
   3. Wall Mount Brackets
   4. Recess Mount Kits
   5. Pole Mount Brackets
   6. Back box mounts
   7. 2x2 Ceiling Mounts
   8. Sun Shields
   9. Work Boxes
   10. Smoked dome covers.
   11. PTZ/Dome housings.
   12. PTZ/Dome mounts.
   13. HD CCTV accessories.
   14. Network camera POE injectors & accessories.
   15. UTP video devices.
   16. Monitor stands.
   17. Surge Protection
   18. UPS Battery Back Up
   19. UPS Circuits

PART 3 - EXECUTION

3.01 PREPARATION

A. System Integrator: Confirm the solution proposal planning and design with the installing contractor (if different company from integrator), to be in compliance with Ochsner standards as described in this document, with any exception approved in writing by Ochsner Security Administration.

B. The network design and configuration to be verified for compatibility and performance with the input/output devices.

C. Network Configuration: Tested and qualified by Systems Integrator prior to remote device installation.

D. Equipment to be tested and configured in accordance with instructions provided by the System Integrator prior to installation.

E. All firmware found in products to be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA).

F. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

G. Confirm hardware will be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

3.02 INSTALLATION

A. Install products per manufacturer's recommendations and approved submittals.
   1. Comply with manufacturer's installation and configuration documentation available to the System Integrator to ensure all steps have been taken to provide a reliable, easy-to-operate system.
      a. System Integrator shall be a Hanwha Techwin (Silver or higher) STEP Partner in good standing with manufacturer.
      b. System Integrator shall provide Technicians that have completed, at minimum, Hanwha WAVE Online Technician Training program.
      c. STEP Partner shall be able to offer extended warranty were applicable.
   2. Program and configure all products per the requirements of Tomball ISD Standards and specific site requirements which shall include, at minimum, the following: (additional requirements may applicable, refer to Tomball ISD Security Administration for details).
      a. All cameras and Network Recorders shall be programmed with Tomball ISD provided IP addresses and password requirements, along with naming guidance as instructed by Tomball ISD Security Administration.
         1) Please contact Tomball ISD IT Dept. and/or Tomball ISD Security for assistance.
      b. All Network Camera Recorders shall use the Tomball ISD NTP (Network Time Protocol) designated server.
      c. All IP Cameras shall have the primary Video Stream programmed to send 15 FPS at 2MP, 5MP, 6MP, 4K (depending on camera model), using the H.265 Codec to stream to the Network Recorder for recording.
      d. All IP Cameras shall have the secondary Video Stream programmed to send 7FPS using H.265 codec to the Network Recorder for client display and non-motion detection recording if motion based alarm recording is implemented.
      e. All IP Cameras shall have a third Video Stream programmed to send 7 FPS at VGA (640x480) using H.264 to the Network Video Recorder for remote access via mobile device as needed.
      f. All indoor cameras shall have video motion detection zones configured and active and walk tested for sensitivity functionality for use during facility closed hours (if applicable to the facility).
      g. All outdoor cameras, if using motion detection, shall have objects such as trees or bushes that can move from the wind, to have motion detection masked off. Outdoor motion detection shall be used carefully for viewing areas considered stable (not plants) such as sidewalks, roads, buildings, doors, and the cameras shall have adequate artificial lighting provided or utilize camera IR light.
      h. All VMS Client Workstations shall be configured to automatically connect to the designated Network Recorders upon launch of the VMS Client application.
      i. Training – User Training may be required and is to be included as needed. Contact Tomball ISD Security Administration for guidance.

B. System Integrator personnel must comply with all applicable state and local licensing requirements.

C. Prior to acceptance of installed system, the System Integrator will test the system in conditions simulating the final installed environment, which shall be witnessed by the Owner or Owner's Representative and shall adjust the complete system as required until proper operation is achieved.
   1. System Integrator shall email a copy of the final approved Wisenet Device Manager Site Configuration File and Wisenet Device Manager Report to Tomball ISD Security Administration as part of the job completion process.

END OF SECTION

28 31 00 - FIRE DETECTION AND ALARM SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1. DESCRIPTION:

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

E. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

F. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

G. The contractor shall field verify all existing device locations and remove them in their entirety including cable. No abandoned cable will be allowed. No cable shall be reused during the installation of the new devices.

H. The contractor shall field verify all AHU equipment and provide a Duct Detector for each unit over 2000 CFM. There is an approximate number of 20 Air handlers in the school that will require a duct detector to be installed. The contractor shall provide the devices and installation of these devices in the base proposal.

I. System shall have a minimum of two loops. Contractor shall not load any loop greater than 75% of its detector loading capacity to allow for future expansion.

J. The contractor shall provide and install new devices in the existing portable buildings. Refer to drawings for approximate portable building locations.

K. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices may not be shown. It is the contractor’s responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein to provide a complete operational system as specified.

L. The drawings show basic device placement to set design criteria. It is the installing contactors responsibility to provide a complete and functional system that meets all applicable codes. The contractor shall include additional devices as required to the design shown to ensure voice

evacuation announcement volume levels are met as well as Visual device lumen outputs are reach acceptable levels.

1.2. SCOPE:

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings to provide a complete smoke detection and fire alarm notification including voice evacuation capabilities.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).

2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.

3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.

4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
6. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.
7. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
8. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
9. Two-way telephone communication circuits shall be supervised for open and short circuit conditions.

C. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the system display shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5. Contractor Qualifications:

A. The installing contractor shall be the authorized representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the fire alarm manufacturer's product for at least two years.

B. The installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.

C. The installing contractor shall have on his staff an installation technician licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.

D. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planning superintendents under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.

E. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.

F. **The installing contractor must have a permanent office within a 75 mile radius of the project site and be an approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.**

G. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems in the surrounding area for at least ten (10) years.

H. All individuals installing the fire alarm system must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.

I. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing fire alarm system contractor will be allowed for any portion of the fire alarm system scope of work.

1.01 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate arrangement of equipment with dimensions and clearance requirements of actual equipment to be installed.
2. Coordinate placement of devices and notification appliances with potential conflicts and view obstructions installed under other sections or by others.
3. Coordinate work to provide power for equipment at required locations.
4. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.02 SUBMITTALS

General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent

compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

A. Submittal Documents:
   1. Prepare and submit information required for plan review and permitting by AHJ, including but not limited to floor plans, details, and calculations.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.

C. Shop Drawings:
   1. Comply with NFPA 72 chapter "Documentation," including noting names of installers, Owner(s), and system classification type information.
   2. Include plan views, drawn to identified scale, noting locations of fire alarm components and associated building or system coordination, as required by NFPA 72.
   3. Include elevations and details of proposed equipment arrangements.
   4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
   5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and end-of-line and power supervisory devices.
   6. Include requirements and control unit diagrams for interfacing with other systems.
   7. Indicate system zone boundaries.
   8. Include narrative description sequence of operation with input/output matrix.
   9. Control Panel: Provide sheet that details exterior and interior views of control panel and clearly shows associated wiring information.
   10. Custom Graphic Annunciators: Include proof for approval prior to fabrication.
   11. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified.

D. Circuit Calculations:
   1. Provide NAC ampacity and voltage drop calculations.
   2. Provide standby battery calculations.
   3. Air Sampling Smoke Detection Systems: Include calculations demonstrating compliance with specified requirements.

E. Inspection and Test Reports:
   1. Installer to submit inspection and test plan prior to closeout demonstration.
   2. Installer to submit NFPA 72 "Record of Inspection and Testing" forms, stored in cloud based service and available via web browser or file download.

F. Installer to submit NFPA 72 "Record of Completion" forms, digitally signed by Owner and authorized representative of AHJ, stored in cloud based service and available via web browser or file download.

G. Certifications:

Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

H. Project Record Documents:
1. Installer to record actual locations of system components and installed wiring arrangements and routing. Indicate final devices, notification appliances, and terminal identifications.
2. Place in as-built documents cabinets.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site.

PART 2 PRODUCTS

1.03 MANUFACTURERS

A. Fire Alarm Control Unit and Accessory Equipment - Basis of Design: Notifier INSPIRE Series by Honeywell; www.securityandfire.honeywell.com/notifier/en-us/browseallcategories/control-panel/notifier-inspire-series/#sle.

B. Source Limitations: Where possible, furnish system components and accessories produced by one manufacturer and obtained from one supplier.

1.04 FIRE ALARM SYSTEM

A. Provide new fire alarm system consisting of required components (e.g., equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, and system programming) as necessary for complete operating system that provides functional intent indicated.

B. Products: Listed, classified, and labeled as suitable for purpose intended.

C. Power Sources:
1. Primary: Dedicated branch circuits from facility power distribution system.
2. Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.
a. Battery Storage Capacity:
1) Provide standby (nonalarm) operation sufficient for 24 hours.
2) Provide additional alarm operation for 5 minutes.
3) Calculate combined of standby load plus alarm load for overall battery storage capacity requirements, per power supply.
4) Provide 25 percent additional overall battery capacity correction factor.

D. General Wiring Methods:
1. Pathway class designations and pathway survivability are as defined in NFPA 72.
2. Pathway Class Designations:
a. Unless otherwise indicated or required, pathways to meet the following requirements:
1) SLCs: Class B.
2) IDCs: Class B.
3) NACs: Class B.
4) Network Communications: Class B.
3. Pathway Survivability:

a. Unless otherwise indicated or required, pathways to meet requirements for Pathway Survivability Level 0.

E. Fire Alarm System Interfaces:
1. UL 864 listed unless otherwise indicated.
2. Descriptions below are intended to provide means for interface. See project sequence of operations, narrative, and input/output matrix for execution requirements.
3. Provide addressable monitor modules as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring points for each device to be individually identifiable by addressable FACU.
4. Provide addressable relay module as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.
5. Fire Suppression Systems:
   a. Releasing Service by FACU:
      1) FACU to be listed for releasing service.
      2) Provide addressable releasing control modules as indicated or as required for control of solenoids listed for releasing applications.
      3) Provide manual releasing stations for suppression system activation as indicated.
      4) Provide alarm bells for audible notification as indicated. Interface to dedicated NAC or addressable control module, 24 VDC, supervised. Default operation to be march time pattern on activation of first event, continuous tone on release.
      5) Provide strobes for visible notification as indicated. Interface to dedicated NAC or addressable control module, 24 VDC, supervised. Default operation to be flash on activation of first event, flash on release.
      6) Provide abort switches as indicated.
6. Elevators:
   a. Elevator Emergency Recall Operation:
      1) In each elevator machine room, provide interface for each elevator car or group of elevator cars as determined by AHJ via separate addressable relay modules for each output signal below, where applicable.
         (a) Recall elevator to designated (primary) level.
         (b) Recall elevator to alternate level.
         (c) Smoke detection in elevator machine room (fire fighter's hat light).
7. Escalators:
8. Fire and Smoke Doors/Shutters/Curtains:
9. Access-Controlled Doors:
10. HVAC Systems:
11. Fire/Smoke Dampers:
   a. Provide output signal to close fire/smoke damper via addressable relay module and power isolation relay.
12. Post-Fire Smoke Removal System - Dedicated, with Control by Fire Alarm System:
   a. Fans Used for Post-Fire Smoke Removal:
      1) Provide interface for the following output signals via addressable relay module and power isolation relay:
         (a) Open shaft isolation damper.
         (b) Start fan.
      2) Provide interface for the following monitoring point inputs:
         (a) Confirmation of shaft isolation damper open status.
         (b) Confirmation of fan operating status.

1.05 FIRE ALARM CONTROL UNIT AND RELATED EQUIPMENT

A. Provide system listed and labeled as complying with agency listings and approval requirements as follows:
   1. UL 864 (Control Units and Accessories for Fire Alarm Systems).
   2. UL 2017 (General-Purpose Signaling Devices and Systems).
   3. UL 2610 (Commercial Premises Security Alarm Units and Systems).
   4. FM (AG) (FM approved).
   5. City of Chicago.
   6. Fire Department of New York (FDNY).
   7. California State Fire Marshall (CSFM).

B. Provide cabinets and enclosures as indicated or as required to house system components.

C. Fire Alarm Control Unit (FACU):
   1. SLCs:
      a. Small panel with enclosure, up to three SLCs.
         1) Supporting up to 954 devices (477 detectors and 477 modules) configurable for Class B or Class A with signaling loop modules.
         2) Configured with no voice and no networking capability.
         3) Provide standard, preconfigured small black enclosure.
   2. FACU User-Interface:
      a. Provide high-definition 10-inch (254 mm) 1024 X 600 color touchscreen display.
      b. Include audible and visible feedback with adjustable brightness solid-state LCD.
      c. Include graphical QWERTY-style keypad on color, touchscreen display when alfa-numeric input is required.
      d. Provide capability to scroll events by type using touchscreen (e.g., fire alarm, supervisory alarm, and trouble).
      e. Permit uploading of custom background image.
      f. Include ability to display up to 3,000 events in order of priority and time of occurrence.
      g. Provide event counters to indicate total number of events by type.
      h. Passwords and Users:
         1) Support five access levels (e.g., system operator, building maintenance user, technician user, admin user, master user) and up to 50 usernames and passwords.
         2) Each role level access has default customizable permissions.
         3) Only master password allows password change.
      i. Custom Actions:
         1) Messages: Provide means of entering up to 100 custom action messages, up to 160 characters each, with ability to assign any of 100 messages to any point.
         2) Button: Support up to 32 programmable custom action buttons on LCD touchscreen display used to enable/disable or control outputs without use of additional hardware.
      j. Support up to ten remote LCD displays. See "Remote LCD Display" below.
   3. Provide FACU based on licensing model to allow for future expansion.
      a. Support licensable features to expand logical operations and features for FACU and display functionality.
      b. Support SLC expansion from one up to ten, using same FACU central processing unit and without need to be replaced or upgraded.
   4. Online, Offline, or Remote Programming:
      a. Provide means to program panel either through offline software utility program nonlocal to panel or connected online remotely via secured gateway.
      b. Support upload/download of programmed database to personal computer (PC) or cloud storage.
   5. History Events:

a. Support software maintained history file for last 10,000 events; each with time and date stamp with ability to scroll through stored events.
b. Include alarms, troubles, operator actions, and programming entries.
c. Provide ability to filter and sort history by event type, date, or point range.

6. Service Mode:
   a. Provide ability to remotely access FACU for programming, testing, and control.
   b. Include customizable time-out feature.
   c. Trouble condition is displayed while in this mode.
7. Support AV magnet test with compatible AV appliances. Provide ability to test individual AV appliances on NAC by applying magnet to appliance momentarily; test does not activate entire circuit, minimizing disruptions during testing and inspection.
8. Support self-testing detector capability.
9. Logical Operators:
   a. Support logical functions, including at minimum: AND (ALL), OR (ANY), NOT, ONLY1, COUNT (one-nine), and TIMERS.
   b. Inputs for Operators: Time of day, addressable devices, software points, and trouble codes.
   c. Capable of differentiating operator inputs by specific device status (i.e., fire alarm, prealarm, nonalarm, disable, supervisory, and security).
10. Virtual Points
    a. The panel will support the creation of up to 511 virtual points capable of activating user-defined signals on the fire alarm display including fire alarm, supervisory, trouble, and security.
    b. Each virtual point will be capable of:
       1) Incorporating unique 40-character custom label.
       2) Activating unique software zones and panel outputs.
       3) Selectively reported to the central station as unique point.
       4) Activation by Software Zones or Logical Zones.
11. SLC Device Sub-addressing
    a. Combination detectors will support operations for each sensing technology independently.
       1) Active sensing technology is clearly visible on each user interface along with the associated panel response (Alarm, Supervisory, etc)
       2) Single combination detector allows for cross-zoning its separate sensing elements for releasing and similar applications.
       3) A sensing technology will be capable of being turned off or ignored via system programming.
    b. Fire Service Access Elevator Implementation (FSAE)
       1) UL 864listed panel for FSAE application
       2) Capable of reporting alarms from thermal detectors while simultaneously monitoring temperature between 65 degrees F (18 degrees C) and 135 degrees F (57 degrees C).
       3) Multicriteria detectors includes unique sub-addresses for normal, monitoring, and unsafe temperatures as well as alarm detection.
       4) Each sub-address for FSAE status is capable of latching until reset or tracking real-time status.
       5) Each sub-address for FSAE status capable of independent mapping for activation of status LEDs.
       6) NORMAL temperature is assumed by the system while the temperature remains below the MONITORING temperature.
       7) The MONITORING and UNSAFE temperatures is configurable in steps of 5 degrees.
          (a) Default MONITORING temperature is 90 degrees Fahrenheit.

(b) Default UNSAFE temperature is 135 degrees Fahrenheit.

12. Smoke Control
    a. UL 864 UUKL Listing
    b. Capable of creating up to 650 user-defined logical smoke control appliances (SC Appliance) corresponding to individual building mechanical components to be controlled and/or monitored by the buildings fire alarm control unit.
        1) Each SC Appliance will:
            (a) Have a unique 40-character label
            (b) Be configurable for operation as either dedicated for smoke control or shared (non-dedicated) with building HVAC (define if not already) automation.
            (c) Monitor operation of the appliance (i.e. damper opened, damper closed, fan on/running, fan off, door opened) through addressable monitor modules.
            (d) Control the appliance through addressable control modules.
            (e) Be capable of monitoring additional fault states through monitor modules such as:
                (1) Trouble
                (2) AC Failure
                (3) Service Disconnect status
            (f) Allow for a unique user customizable fault delay timer up to 255 seconds.
    c. Capable of creating up to 650 local smoke control zones (SC Zone) for controlling multiple smoke control appliances.
        1) SC Zones are configured with one or more operations including:
            (a) PRESSURIZE
            (b) PURGE.
            (c) EXHAUST
        2) Each SC Zone:
            (a) allows for ISOLATE and TEST configurations.
            (b) Automatically report the operating and fault statuses without the need of manually creating additional logical functions.
            (c) Allow for customizable scenarios for weekly testing of equipment per SC Appliance.
        3) Associations of appliance states per SC Zone are made via a simple input-output matrix format.
        4) SC Zones are capable of lockout by first-in or last-in priority to prevent conflicting configurations.
13. Releasing Service via Addressable Releasing Control Modules:
    a. Agent Releasing:
        1) FACU to be capable of supporting 10 releasing zones for independent hazards, with each zone capable of three cross-zone and four abort options; provide adjustable delay and discharge timers.
    b. Water Releasing:
        1) FACU support for 100 water releasing zones.
            (a) Up to 10 input sources either local panel or across fire alarm network.
    c. Addressable Releasing Control Modules: See "Addressable Modules" in this article below.
    d. Manual Release Station: See "Manual Pull Stations" under "Fire Alarm System Initiating Devices" article below.
    e. Bells and Strobes: See "Fire Alarm System Notification Appliances" article below.
14. Support up to 80 addressable panel annunciators. See "Addressable Panel Annunciators" below.
15. FACU Main Power Supply:

a. Provide addressable main power supply with universal input to accept either 120/240 VAC, 60 Hz, supplying all necessary power for FACU.
b. Include minimum four integral and programmable NACs.
1) Provide onboard patterns, zone coding, and synchronization (System Sensor, Wheelock, and Gentex).
c. Supply power distribution of each addressable main power supply that can be customizable to provide power for system, NAC, supporting circuits, auxiliary, and battery charging.
d. Power supply supports up to 210 AH batteries.

16. Basis of Design Products:
a. Notifier INSPIRE Series Model N16e with one SLM-318 included (expandable to three), 10-inch (254 mm) touchscreen display, and power supply with four NACs within black enclosure.
b. Notifier Model SLM-318; signal loop module.

D. Alarm Transmission and Integration:
1. Integrated Gateway:
a. FCC compliant.
b. Provide gateway for connection to fire system panel or panel network, serving as interface between FACU, supervising/central station, cloud services and peripheral devices.
c. Able to read connected device system database for individual FACU or network of panels and automated report creation for supervising/central station.
d. Reduce transfer times to supervising/central stations, dispatch centers, and emergency responders by eliminating need for additional transmission equipment (e.g., alarm-capture devices, and dialers) and associated processing delays while increasing reliability and accuracy of alarm transmission.
e. Enable detailed context sharing directly with first responders upon fire event to improve emergency response efficiency.
f. Capable of alarm transmission over Ethernet or Wi-Fi networks.
g. Enable integration directly to private radio communicator via Ethernet connection
h. Enable supplementary transmission of real-time data from fire alarm system to cloud service to enable remote monitoring of events via web application or mobile device application.
i. Provide lockable plastic cabinet which is keyed identical to FACU.
2. Basis of Design Products:
a. Integrated Gateway; Honeywell Model HON-CGW-MBB (CLSS gateway with enclosure) with Model 50160636-001 (keylock and cable kit) with support for monitoring via any supervising/central station.

E. Addressable Panel Annunciators:
1. Comply with UL 864.
2. Provide plug-in terminal blocks for wiring connections.
3. Buttons and indicators capable of custom programming up to 60 points of annunciation.
4. Provide trichromatic LEDs (RGB) for custom colors as follows: red, green, yellow, white, amber, blue, cyan, or purple.
5. Include 30 pushbuttons with two corresponding LEDs each.
6. Each pushbutton and LED can be programmed independently for different points or grouped with other indicators for cooperative operation.
7. Provide reindication of alarm or trouble by resounding and flashing when new conditions occur.
8. Provide local sounder for alarm and trouble conditions; include programming option to silence/acknowledge by pushbutton.
9. Capable of speaker control mode with integrated voice and FACU, allowing remote control for groups of multi-channels mapped to groups of multi-speakers.

10. Basis of Design Products:
    a. Notifier Model ACM-30 fully customizable annunciator; independently configured buttons; up to 60 points; programmable LEDs.
        1) Notifier Model CAB-4 or CAB-5 dress panel or compatible backbox for mounting.

F. Lamp Driver Modules:
1. Provide module with 60 LED outputs and 21 switch inputs per module for interface with graphic annunciators.
2. May be located up to 6,000 feet (1828 m) from FACU.
3. Inputs programmable for:
    a. System acknowledge
    b. Signal silence
    c. Reset
    d. Initiate drill
    e. Control or disable panel or SLC output point, software point, or audio control point
4. Switches configurable as momentary or toggle.
5. Support 5 VDC or 24 VDC LEDs.
    a. Each LED output capable of steady and flashing operation.
6. Basis of Design Products:
    a. Notifier Module LDM2-60 lamp driver module.

G. Remote LCD Display:
1. Comply with UL 864.
2. Capable of mimicking display of either FACU or network control display, based on connection or only information per specific zones.
3. Provide plug-in terminal blocks for wiring connections.
4. Provide 5-inch (127 mm) capacitive full color touchscreen LCD annunciator that displays all system events.
5. Block Acknowledge: Support block acknowledge for trouble and disable conditions.
6. Provide programmer key switch for user authentication, providing ability to enable control inputs for acknowledge, silence, reset, and drill.
7. Provide configurable control buttons that are operational only when keyswitch is unlocked.
8. Provide six programmable buttons, each with descriptor/label, status indicator and configurable action (on/off, disable/enable).
9. Capable of being field programmed using PC configuration software.
    a. Provide standard USB-C connection for software interface.
10. Basis of Design Products:
    a. Notifier Model RLD network control annunciator, 5-inch (127 mm) color touch screen display; mounts in standard 3-gang backbox.

H. Notification Appliance Circuit (NAC) Expansion:
1. Comply with UL 864.
2. Where NAC requirements exceed capacity of FACU, provide accessories as required for expansion.
3. Cabinet-mounted with capacity for providing 10 A 24 VDC notification appliance power and 7 Class B NAC outputs.
    a. Include self-contained, lockable cabinet capable of storing 7 or 18 AH batteries.
    b. Battery charger capacity capable of charging 7 AH to 33 AH sealed lead acid batteries.
    c. Provide three activation inputs which allow for synchronization pass-through and can be associated with any combination of NAC outputs.
4. Where Class A NACs are required, provide Class A module to enable each NAC to be configured as Class A.
5. Provide integral synchronization of both audio and visual circuits to match protocol assigned by FACU.

6. Basis of Design Products:
    a. Honeywell Model HPF-PS10; 10 A notification power expander with seven 24 VDC individually configurable outputs, red metal enclosure.
        1) ZNAC-PS Class A output converter module.

I. Electromagnetic Door Holders:
1. Select according to door type and associated installation conditions.
2. Basis of Design Products:
    a. Honeywell Model FM Series; model number selected according to application.

1.06 FIRE ALARM SYSTEM INITIATING DEVICES

A. General Requirements:
1. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs. Provide address-setting means on device using rotary switches with simple numerical indicators. Devices which require proprietary tools or dip switches to address device will not be accepted.
2. Conventional (Nonaddressable) Devices: Provide addressable monitor modules or two-wire detector zone modules (See "Addressable Interface Modules" article for Basis of Design Products) as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring point for each device in order to be individually identifiable by addressable FACU.
3. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable monitor modules only in clean, dry, indoor, nonhazardous locations.
4. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
5. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes and enclosures in accordance with product listing.
6. Devices for Hazardous (Classified) Locations: Listed and labeled as suitable for classification of installed location.

B. Self-Testing Devices:
1. Capable of CLSS identifying issues associated with integrity or ability for smoke detector to properly detect smoke (e.g., dust cap not removed or tampering with detector by obstructing smoke chamber.
2. Capable of providing functional and smoke entry tests using self-test function.
    a. Detector transmits 'wireless beacon activated' only during self-test mode.
    b. Designed to communicate with CLSS app to prove successful completion of visual inspection.

C. Manual Fire Alarm Boxes (Pull Stations):
1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
3. Operation: Dual-action unless otherwise indicated; first requires pushing in then pulling down of lever.
4. Color: Red, in accordance with NFPA 72.
5. Station Reset: Requires use of key or tool.
6. Basis of Design Products:
    a. Manual Pull Stations:
        1) Notifier Model NBG-12LX addressable manual pull station, indoor rated, dual-action, key lock.

D. Spot-Type Detectors:

1. Addressable Detectors:
   a. Comply with "General Requirements for Addressable Devices."
   b. Provide LED indication of normal operation/regular communication with FACU condition.
   c. Furnished with output for remote LED alarm indicator.
   d. Utilizes plug-in mounting to separate base with tamper-resistant feature; compatible with available sounder, relay, and isolator bases; provide base as indicated or as required.
2. Smoke Detectors:
   a. Listed and labeled as complying with UL 268.
   b. Use photoelectric (light-scattering) principal to measure smoke density.
   c. Provide data to FACU representing analog level of smoke density.
   d. Self-Testing Smoke Detectors:
      1) Self-generate controlled amount of smoke into chamber, testing optic response to real smoke simulation.
      2) Detector measures dilution of smoke within set time limits to determine if there is masking preventing smoke from entering chamber.
      3) Generate detector alarm condition upon smoke entering chamber.
      4) Detector generates trouble condition if testing chamber is blocked.
3. Thermal (Heat) Detectors:
   a. Listed and labeled as complying with UL 521.
   b. Listed for tenability monitoring when used with FSAE applications.
   c. Self-Testing Thermal (Heat) Detectors:
      1) Self-generate energy into internal thermistor, allowing register heat identification.
      2) Detector measure cooling of heating element after cycle complete.
      3) Generate detector alarm condition upon introduction of heat from thermistor.
      4) Detector generates trouble condition if thermistor does not detect heat.
      5)
4. Carbon Monoxide Detectors:
   a. Listed and labeled as complying with UL 2075.
   b. Comply with requirements for addressable detectors unless otherwise noted for areas where addressable devices are not feasible.
   c. Furnished with end-of-life notification.
5. Combination and Multi-Criteria Detectors:
   a. Comply with respective requirements for each detection method.
   b. Capable of generating unique events per detection method.
   c. Self-Testing Multi-Criteria Detectors: Comply with respective self-testing requirements.
6. Detector/Base Color: White, unless otherwise indicated.
7. Basis of Design Products:
   a. Smoke Detectors:
      1) Notifier Model FSP-951T addressable smoke/thermal detector, indoor rated, photoelectric, integral drift compensation, self-diagnostics, transient rejection, local test via application of external magnet.
      2) Notifier Model FSV-951R addressable high-sensitivity smoke detector, photoelectric; very early warning fire detection (VEWFD) capability; integral drift compensation, self-diagnostics, transient rejection, local test via application of external magnet.
      3) Notifier Model FSP-951-SELFT self-test addressable smoke detector, indoor rated, photoelectric.
   b. Thermal (Heat) Detectors:
      1) Notifier Model FST-951-SELFT self-test addressable thermal detector, indoor rated.

c. Carbon Monoxide Detectors:
   1) Notifier Model FSCO-951 addressable carbon monoxide detector, indoor rated.
d. Combination/Multi-Criteria Detectors:
   1) Notifier Model FSP-951T-SELFT self-test addressable smoke/thermal detector, indoor rated.
e. Bases for Addressable Detectors:
   1) Notifier Model B300-6 Series standard base, flanged low-profile.

E. Duct Smoke Detectors:
1. Listed and labeled as complying with UL 268A.
2. Sampling Tubes: Select as required for installation in duct to be monitored.
3. Remote Test Stations: Provide remote test station for each duct smoke detector unless explicitly indicated as not required. Unless otherwise indicated, use remote test stations only in clean, dry, indoor, nonhazardous locations.
4. Basis of Design Products:
   a. Addressable duct smoke detector assembly for indoor applications consisting of the following:
      1) Notifier Model DNR duct smoke detector housing, indoor rated.
         (a) Notifier Model FSP-951R addressable smoke detector, indoor rated, photoelectric, remote test capable.
         (b) Notifier DST Series sampling tube of appropriate length.
   b. Addressable duct smoke detector assembly for outdoor applications consisting of the following:
      1) Notifier Model DNRW duct smoke detector housing, weatherproof.
         (a) Notifier Model FSP-951R addressable smoke detector, indoor rated, photoelectric, remote test capable.
         (b) Notifier DST Series sampling tube of appropriate length.
         (c) Notifier Model DH400OE-1 weatherproof enclosure for housing components listed above. Fill interior of enclosure with appropriate insulation media to minimize condensation.
   c. Notifier Model RTS151KEY remote test station for addressable detectors; allows for detector test (via external magnet application) and key reset; provides LED indication of alarm condition.

F. Beam Smoke Detectors:
1. Listed and labeled as complying with UL 268.
2. Provide coverage for 16 to 328 feet (5 to 100 m) standard.
3. Use advanced smoke imaging techniques to avoid false alarms from partial and sudden blockage from foreign object intrusion.
4. Provide automatic drift compensation and sensitivity threshold level settings.
5. Provide four automatic sensitivity levels (25, 30, 40, and 50 percent).
6. UL listed operating temperature from 32 degrees F (100 degrees F).
7. Provide paintable cover.
8. Basis of Design Products:
   a. Notifier Model FS-OSI-RI addressable beam video-imaging detector, single-ended reflected beam type with transmitter unit and reflector; protection range of 16 to 328 feet (5 to 100 m) with standard reflector; beam adjustment angle of plus/minus 10 degrees. Furnish accessories as indicated or as required.
   b. Notifier Model RTS151KEY remote test station for addressable detectors; allows for detector test (via external magnet application) and key reset; provides LED indication of alarm condition.

G. Air-Sampling Smoke Detection Systems:
1. Design and provide smoke detection system suitable for application and coverage area indicated, consisting of smoke detector unit with aspirator/fan that continuously draws air

into sensing chamber through connected sampling pipe network and associated sampling ports.

2. Comply with NFPA 72 and list and label as complying with UL 268.
3. Comply with applicable requirements of NFPA 76 for very early warning fire detection (VEWFD).
4. Detector Unit:
   a. Sensitivity: Programmable; capable of meeting NFPA 76 requirements for Very Early Warning Fire Detection (VEWFD) even if system is designed and programmed for to be less stringent.
   b. Smoke Detection Method: Laser-based light scattering mass detection.
   c. Alarm Levels: Programmable; as indicated or as required to perform alert, prealarm action, and alarm functions; minimum of four.
   d. Allow aspirated detector and SLC module firmware upgrade in field lowering maintenance and upgrade cost during potential field issues.
   e. Display: Provides local annunciation of detector trouble and alarm status.
5. Sampling Pipe Network:
   a. Use manufacturer's recommended sampling pipe and fittings; plenum rated; identified in accordance with NFPA 72.
   b. Designed using manufacturer's product-specific design software or based on manufacturer's pre-engineered design suitable for intended application.
6. FACU Interface:
   a. Communicates up to five levels of events to FACU via SLC interface for display and use in control-by-event system programming.
   b. Allows access to real-time status information at FACU including alarms and faults.
7. Basis of Design: Xtralis VESDA-E Aspirating Smoke Detection.
   a. Xtralis VESDA-E VEP Series; Model VEP-A00-1P-NTF-VN: Addressable, single pipe, coverage up to 10,760 sq feet (1,000 sq m).
   b. Xtralis VESDA-E VEP Series; Model VEP-A10-P-NTF-VN: Addressable, four pipes, 3.5-inch (89 mm) LCD display, coverage up to 21,520 sq feet (2,000 sq m).
   c. Xtralis VESDA-E VEP Series; Model VEP-A00-P-NTF-VN: Addressable, four pipes, coverage up to 21,520 sq feet (2,000 sq m).
   d. Xtralis VESDA-E VEU Series; Model VEU-A10-NTF-VN: Addressable, four pipes, 3.5-inch (89 mm) LCD display, coverage up to 69,965 sq feet (6,500 sq m).
   e. Xtralis VESDA-E VEU Series; Model VEU-A11-NTF-VN: Addressable, four pipes, coverage up to 69,965 sq feet (6,500 sq m).
   f. Xtralis VESDA-E VEA Series; Model VEA-040-A00-NTF-UL: Addressable, four pipes, coverage up to 36,000 sq feet (3,345 sq m) .
   g. Xtralis VESDA-E VEA Series; Model VEA-040-A10-NTF-UL: Addressable, four pipes, 3.5-inch (89 mm) LCD display, coverage up to 36,000 sq feet (3,345 sq m).
   h. Xtralis VESDA-E VES Series; Model VES-A00-P-NTF-VN: Addressable, four pipes, increased alarm thresholds and relay outputs, autoLearn (smoke/flow), coverage up to 21,520 sq feet (2,000 sq m).
   i. Xtralis VESDA-E VES Series; Model VES-A10-P-NTF-VN: Addressable, four pipes, 3.5-inch (89 mm) LCD display, increased alarm thresholds and relay outputs, autoLearn (smoke/flow), coverage up to 21,520 sq feet (2,000 sq m).

1.07 FIRE ALARM SYSTEM INTERFACE MODULES

A. Fire alarm system accessory equipment listed and labeled as complying with UL 864.

B. Provide addressable interface modules as indicated or required for fire alarm and nonfire alarm interfaced systems.

C. Individually identifiable by addressable FACU; suitable for connection to FACU SLCs. Provide address-setting means on device using rotary switches with simple numerical indicators. Devices which require proprietary tools or dip switches to address device will not be accepted.

D. Provide addressable modules suitable for connection to FACU SLCs.

E. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.

F. Addressable Monitor Modules: Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable FACU.

G. Addressable Control Modules: Provide as indicated or as required for selective control of notification appliances.

H. Addressable Releasing Control Modules: Provide as indicated or as required for control of listed solenoids in releasing applications.

I. Addressable Relay Modules: Provide as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.

J. Addressable Signaling Line Circuit (SLC) Isolating Modules: Provide as indicated or as required to automatically isolate short circuits on connected sections of SLC loops and allow other sections to continue to function normally. Provide automatic reset upon correction of short circuit.

K. Basis of Design Products:
   1. Addressable Monitor Modules:
      a. Notifier Model FMM-1 addressable monitor module; single monitoring point, supervises one Class A or Class B circuit of conventional dry-contact input devices; uses single module address on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
      b. Notifier Model FDM-1 addressable monitor module; two monitoring points, supervises two Class B circuits of dry-contact input devices; uses two module addresses on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
      c. Notifier Model FMM-101 addressable monitor module, miniature; single monitoring point, supervises one Class B circuit of conventional dry-contact input devices; suitable for installation within appropriately sized device box behind monitored unit; uses single module address on SLC.
      d. Notifier Model FZM-1 addressable two-wire detector zone module; single zone monitoring point, supervises one Class A or Class B zone of compatible two-wire conventional smoke detectors; requires separate 24 VDC power; uses single module address on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
      e. Notifier Model XP10-M addressable multi-monitor module; ten monitoring points, supervises ten Class B circuits of dry-contact input devices; uses ten module addresses on SLC; mounts to CHS-6 chassis within enclosure.
      f. Notifier Model XP6-MA addressable multi-monitor module; six zone monitoring points, supervises six Class A or three Class B zones of compatible two-wire conventional smoke detectors; requires separate 24 VDC power; uses six module address on SLC; mounts to CHS-6 chassis within enclosure.
   2. Addressable Control Modules:
      a. Notifier Model FCM-1 addressable control module; single supervised control output, Class A or Class B, suitable for controlling 24 VDC NAC and speakers up to 70.7 Vrms; requires separate power; uses single module address on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
      b. Notifier Model XP6-C addressable multi-control module; six Class B or three Class A supervised control outputs, suitable for controlling 24 VDC NAC and speakers up to 70.7 Vrms; requires separate power; uses six module addresses on SLC; mounts to CHS-6 chassis within enclosure.

3. Addressable Releasing Control Module:
   a. Notifier Model FCM-1-REL addressable releasing control module; single supervised solenoid release output, Class A or Class B, suitable for connection to one 24 VDC solenoid or up to two 12 VDC solenoids (in series) listed for releasing service; utilizes redundant protocol; requires separate 24 VDC power; uses single module address on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
4. Addressable Relay Modules:
   a. Notifier Model FRM-1 addressable relay module; two Form C dry contacts that switch together; uses single module address on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
   b. Notifier Model XP6-R addressable multi-relay module; Six individually programmable Form C dry contacts; uses six module addresses on SLC; mounts to CHS-6 chassis within enclosure.
5. Addressable Multi-Input/Output Modules:
   a. Notifier Model FDRM-1 addressable multi-input/output module; two monitoring points, supervises two Class B circuits of dry-contact input devices; two Form C dry contacts that operate independently; uses up to four module addresses on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
6. Addressable Signaling Line Circuit (SLC) Isolating Modules:
   a. Notifier Model ISO-X addressable signaling loop circuit (SLC) isolating module; does not use any module addresses on SLC; mounts to nominal 4-inch (102 mm) square or 2-gang box, includes white finish cover.
   b. Notifier Model ISO-6 addressable signaling loop circuit (SLC) isolating module; does not use any module addresses on SLC; mounts on CHS-6 chassis within enclosure.
7. Accessories:
   a. Notifier Model PR-1 power isolation relay for loads exceeding relay module contact ratings; operating voltage of 18-35 VDC, 18-35 VAC, or 120 VAC; LED visible indication of relay coil energization.

1.08 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

A. Notification Appliances - General Requirements:
   1. Provide signaling devices listed for fire-protective service and intended operating mode (public or private); suitable for connection to FACU notification NAC.
   2. Provide addressable control modules as indicated or as required for selective control of notification appliances.
   3. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (i.e., ceiling or wall mounted).
   4. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
   5. Notification Appliances for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes and enclosures in accordance with product listing.
   6. Notification Appliance Derating: Account for device derating adjustments in accordance with listing where applicable, including but not limited to the following.
      a. Where accessory protective guards, and enclosures are utilized.
      b. Where required by field conditions (e.g., ambient temperature).
   7. Notification Appliances Colors:
      a. See mounting configuration indicated by floor plan drawing symbols.
      b. Wall-Mounted: White.
      c. Ceiling-Mounted: White.

B. Visible Notification Appliances:
   1. Public Mode Operation: Listed and labeled as complying with UL 1971.

2. Strobes: Clear or nominal white lens with flash rate of 1 Hz unless otherwise indicated or required; xenon light source with maximum pulse duration of 0.2 seconds; candela rating as indicated.

C. Audible Notification Appliances:
1. Listed and labeled as complying with UL 464.
2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dB(A) at 10 feet (3.1 m) for public mode operation or 45 dB(A) at 10 feet (3.1 m) for private mode operation in accordance with UL 464.
3. Horns: Selectable tone, including at minimum NFPA 72-compliant temporal 3 pattern and continuous; minimum of two selectable volume levels.

D. Combination Notification Appliances: Comply with respective requirements for each signaling method.

E. Basis of Design Products:
1. Strobes:
a. Notifier Model SWLED strobe, indoor rated, wall-mounted, white, selectable candela output (15, 30, 75, 95, 110, 135, 185 at 24 VDC nominal).
b. Notifier Model SGWLED strobe, compact, indoor rated, wall-mounted, white, selectable candela output (15, 30, 75, 95, 110, 135, 185 at 24 VDC nominal).
c. Notifier Model SWK strobe, weatherproof (includes backbox), wall-mounted, white, selectable candela output (15, 15/75, 30, 75, 95, 110, 115 at 24 VDC nominal).
d. Notifier Model SCWLED strobe, indoor rated, ceiling-mounted, white, selectable candela output (15, 30, 75, 95, 115, 150, 177 at 24 VDC nominal).
e. Notifier Model SCWKLED strobe, weatherproof (includes backbox), ceiling-mounted, white, selectable candela output (15, 15/75, 30, 75, 95, 110, 115 at 24 VDC nominal).
f. Notifier Model SCWHKLED-P strobe, plain, weatherproof (includes backbox), wall-mounted, white, selectable candela output (135, 150, 177, 185 at 24 VDC nominal).
2. Horns:
a. Notifier Model HWL horn, indoor rated, wall-mounted, white.
b. Notifier Model HGRL horn, compact, indoor rated, wall-mounted, white.
c. Notifier Model MHW mini-horn, indoor rated, white.
d. Notifier Model HWK horn, weatherproof (includes backbox), wall-mounted, white.
e. Notifier Model MHW mini-horn, indoor rated, white.
3. Horn/Strobes:
a. Notifier Model P2WLED horn/strobe, indoor rated, wall-mounted, white, selectable candela output (15, 30, 75, 95, 110, 135, 185 at 24 VDC nominal).
b. Notifier Model P2GWLED horn/strobe, compact, indoor rated, wall-mounted, white, selectable candela output (15, 30, 75, 95, 110, 115, 135, 150, 177, 185 at 24 VDC nominal).
c. Notifier Model P2GWKLED horn/strobe, weatherproof (includes backbox), wall-mounted, white, selectable candela output (15, 15/75, 30, 75, 95, 110, 115 at 24 VDC nominal).
d. Notifier Model P2WHK horn/strobe, weatherproof (includes backbox), wall-mounted, white, selectable candela output (135, 150, 177, 185 at 24 VDC nominal).
e. Notifier Model PC2WLED horn/strobe, indoor rated, ceiling-mounted, white, selectable candela output (15, 30, 75, 95, 115, 150, 177 at 24 VDC nominal).
f. Notifier Model PC2WKLED horn/strobe, weatherproof (includes backbox), ceiling-mounted, white, selectable candela output (15, 15/75, 30, 75, 95, 110, 115 at 24 VDC nominal).
g. Notifier Model PC2WHK horn/strobe, weatherproof (includes backbox), ceiling-mounted, white, selectable candela output (135, 150, 177, 185 at 24 VDC nominal).
h. Notifier Model P2RLED-P horn/strobe, plain (no "FIRE" marking), indoor rated, wall-mounted, red, selectable candela output (15, 30, 75, 95, 110, 135, 185 at 24 VDC nominal).

i. Notifier Model P2WLED-P horn/strobe, plain (no "FIRE" marking), indoor rated, wall-mounted, white, selectable candela output (15, 30, 75, 95, 110, 135, 185 at 24 VDC nominal)

1.09 FIRE ALARM SYSTEM ACCESSORIES

A. Cables for Network Connections:
   1. Comply with manufacturer's minimum requirements.

B. Fire Alarm System Documents and Software Cabinet:
   1. Provide fire alarm document (FAD) cabinet with size as indicated or as required.
   2. Cabinet: Steel with red finish; permanently identified with text "FIRE ALARM SYSTEM DOCUMENTS"; keyed to match fire alarm system equipment; include fixed integral minimum 2 GB flash drive for electronic storage of system documents and system database program

C. Terminal Cabinets:
   1. Provide terminal cabinets with quantity of termination points as indicated or as required for application.
   2. Cabinet: Steel, with red finish; permanently identified with text "FIRE ALARM TERMINAL CABINET"; keyed to match fire alarm system equipment.
   3. Terminal Strips: Rated for 20 A at 250 VAC; terminal points rated for 12 AWG conductors.

D. As-Built Document Cabinets:
   1. Provide as-built document cabinet with size as indicated or as required.
   2. Cabinet: Steel with red finish; permanently identified with text "AS-BUILT DRAWINGS"; keyed to match fire alarm system equipment.

E. Emergency Access Key Vaults:
   1. Listed; complying with requirements of AHJ.
   2. Unless otherwise indicated, utilize recess mounting for new construction and surface-mounting for existing structures.
   3. Color: Black, unless otherwise indicated or directed by Engineer.

F. Surge Protection:
   1. Line Voltage Surge Protection: UL 1449 listed; provide for each line voltage circuit that supplies operating power for fire alarm system control equipment (e.g., FACU, field booster panels, nodes, and transponders).
   2. Low Voltage Surge Protection: Listed, voltage/current ratings suitable for circuit to be protected; provide for each power limited low voltage circuit that exits protected premises.

PART 3 EXECUTION

2.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that characteristics of system components are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that circuit wiring installation is completed, tested, and ready for connection to system where applicable per conductor requirements of NFPA 72 tables located in chapter "Inspection, Testing, and Maintenance."

E. Verify that conditions are satisfactory for installation prior to starting work.

2.02 INSTALLATION

A. Install products in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicate on drawings.

B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).

C. Adjust selectable candela strobes to rating indicated on design documents.

D. Provide grounding and bonding in accordance with manufacturer's recommendations; see Section 260526.

E. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

F. Identify system wiring, components, and overcurrent protective devices for branch circuits serving fire alarm system; see Section 260553.

G. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas; maintain code required access.

H. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.

I. Mount fire detection and alarm system devices, control panels, and remote annunciators flush or surface as indicated.

J. Ensure installation locations of devices and notification appliances are in accordance with local codes, standards, and ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on drawings. Install not less than 42-inches (1.07 m), nor more than 48-inches (1.22 m), above finished floor measured to operating handle.

END OF SECTION

28 50 00 – PERSONAL VAPORIZER DETECTION SYSTEM

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Scope
1. Contractor shall provide and install all necessary vape devices, cabling, power supplies, mounting kits, software, and programming to ensure a fully functional vape detection system. Contractor shall refer to technology drawings for locations and quantities.

B. General Requirements
1. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
2. The specified unit shall be based upon standard components and proven technology using open and published protocols.

C. Sustainability
1. The specified unit shall be manufactured in accordance with ISO 9001.
2. The specified unit shall be compliant with the EU directives 2011/65/EU (CE).
3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
4. The specified unit shall be Halogen-free in accordance with IEC 61249-2-21.

1.02 CERTIFICATIONS AND STANDARDS

A. General abbreviations and acronyms
1. AES: Advanced Encryption Standard
2. API: Application Programming Interface
3. AQI: Air Quality Index
4. Aspect ratio: A ratio of width to height in images
5. BACnet: Building Automation and Control (BAC) Network
6. Bit Rate: The number of bits/time unit sent over a network
7. Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
8. DHCP: Dynamic Host Configuration Protocol
9. DNS: Domain Name System
10. FPS: Frames per Second
11. FTP: File Transfer Protocol
12. IEEE 802.1x: Authentication framework for network devices
13. HTTP: HyperText Transfer Protocol
14. HTTPS: Hypertext Transfer Protocol Secure
15. IAQ: Indoor Air Quality
16. IP: Internet Protocol
17. ISO: International Standards Organization
18. LAN: Local Area Network

19. LED: Light Emitting Diode
20. MPEG: Moving Picture Experts Group
21. MJPEG: Motion JPEG (M-JPEG or MJPEG) is a video compression format in which each video frame or interlaced field of a digital video sequence is compressed separately as a JPEG image.
22. Multicast: Communication between a single sender and multiple receivers on a network
23. NTP: Network Time Protocol
24. PoE: Power over Ethernet (IEEE 802.3af Class 3 Compliance, 80 mA) standard for providing power over network cable
25. QoS: Quality of Service
26. RTSP: Real Time Streaming Protocol
27. SMTP: Simple Mail Transfer Protocol
28. SNMP: Simple Network Management Protocol
29. SSL: Secure Sockets Layer
30. TCP: Transmission Control Protocol
31. TLS: Transport Layer Security
32. Unicast: Communication between a single sender and single receiver on a network

B. The specified unit shall carry the following EMC approvals:
1. EN 55024:2010
2. FCC 47 CFR Part 15 - Subpart B Class A
3. EN 55032:2012 + AC:2013
4. ICES-003 ISSUE 6:2016

C. The specified unit shall meet the following product safety standards:
1. IEC / EN / CE / WEEE / UL 60950-1 / CUL 60950-1

D. The specified unit shall meet the following standards
1. Networking:
    a. IEEE 802.3af Class 3 Compliance, 125 mA)
    b. IEEE 802.1X (Authentication)
    c. IPv4 (RFC 791)
    d. IPv6 (RFC 2460)
    e. WiFi
2. Mechanical Environment:
    a. IEC/EN 62262
    b. Vandal Resistance with at least an IK-10 rating

1.03 QUALITY ASSURANCE

A. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.

B. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, as proof of the knowledge.

C. The specified unit shall be manufactured in accordance with ISO9001.

1.04 WARRANTY

A. The manufacturer shall provide warranty for (1) one year and optional extended warranty for the sensor for a total period of three years.

PART 2 PRODUCTS

2.01 GENERAL

A. Sensor shall be IP-based and comply with established network standards.

B. Sensors shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.

C. Sensors shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

2.02 SENSOR SCHEDULE

A. Sensors listed below *shall* be supplied by a single manufacturer. Contractor shall refer to technology drawings for exact locations and quantities.

B. The sensor manufacturer and model numbers will be as follows:
   1. Motorola Corporation – HALO Smart Sensor
      a. Model type: HALO-3C

2.03 SENSORS

A. Interior mounted Smart Sensor
   1. Provide sensors in gang restrooms for all secondary campuses.
      a. Contractor shall provide and install all mounting hardware for ceiling installation.
   2. The sensor shall meet or exceed the following design specifications:
      a. Each sensor is connected from device back to nearest MDF/IDF closet via Category 6 data cabling back to campus network switch.
      b. The sensor shall operate on an open source; Linux-based platform and include a built-in web server.
      c. The sensor shall provide local database storage utilizing internal memory.
      d. The sensor shall be manufactured with an IP30-rated, IK10 impact-resistant, polycarbonate casing.
      e. The sensor certified to operate in plenum space.
   3. The sensor shall meet or exceed the following performance specifications:
      a. Detection and measurement of
         1. Particulates Size 1 µm particulates µg/m³

2. Particulates Size 2.5 µm particulates µg/m³
3. Particulates Size 10 µm particulates µg/m³
4. Carbon Dioxide Equivalents
5. Total Volatile Organic Compounds
6. Carbon Monoxide
7. Ammonia
8. Temperature/Humidity
9. Barometric Pressure
10. Light Level
11. Sound Levels
12. Tamper
13. Vape
14. Vape THC
15. Spoken Keyword
16. Gunshot
17. Aggression
18. Masking / Spray Paint
19. Indoor Air Quality, AQI: Air Quality Index

b. Scheduling
   1. Shall have day and time selection for notification of detection.
   2. Shall have the scheduling be adjustable separately for each detection type.

c. Audio microphones
   1. Shall have (2) two microphones
   2. Sensor shall perform audio analysis only
   3. Sensor shall not record live audio stream

d. LED Indicator Light
   1. The sensor shall have a multi-color LED indicator (ALGO 8128 or similar).

e. Speaker
   1. The sensor shall have a speaker.

f. Encoding of Data Screen
   1. The sensor shall support the following video encoding algorithms:
      a. Motion JPEG encoding of 1 frame per second.

g. Video Transmission
   1. The sensor shall allow for video to be transported over:
      a. HTTP (Unicast)
      b. HTTPS
      c. RTSP

h. User Interface
   1. Web server
      a. The sensor shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP and HTTPS, without the need for additional software.

i. IP addresses
    1. The sensor shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
    2. The sensor shall allow for automatic detection of the sensor based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
    3. The sensor shall provide support for IPv4.
    4. The sensor shall provide support for IPv6.

j. Event functionality
    1. The sensor shall be equipped with an integrated event functionality, which can be triggered by:
        a. Sensor tampering
        b. Manual Trigger/Virtual Inputs
        c. Event threshold met
    2. Response to triggers shall include:
        a. Relays Outputs
            1. (2) Two relay outputs
            2. Normally Open or Closed
            3. Rated at 48VDC at 1 amp
        b. Status Light
        c. Speaker
            1. Pre-Recorded Files
            2. Programmable
        d. Send notification, using HTTP, HTTPS, TCP, RTSP, or Email
        e. Send images, using FTP, HTTP, HTTPS, RTSP, network share or email
        f. Identification in data logs

k. Protocol
    1. The sensor shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SSL/TLS, TCP, ICMP, SMTP, DHCP, UPnP, ARP, DNS, NTP, RTSP, Bonjour.
    2. The SMTP implementation shall include support for SMTP authentication.

l. Security
    1. The sensor shall be in compliance with California’s law for IoT device cyber security, California Civil Code Section 1798.91.04.
    2. The sensor shall restrict access to the built-in web server by usernames and passwords at two different levels.
    3. The sensor shall have minimum user-name and password criteria requirements.

m. Configurability
    1. Network system configuration and sequence of operation shall be programmed by Owner once system is installed.
    2. The sensor shall permit configuration of Event thresholds, time requirements, filters, and combinational Events. Built in test functions shall be provided.
    3. The sensor shall permit configuration live viewing elements, live viewing style/colors, and live viewing ranges
    4. Sensor shall permit configuration of Actions including lighting patterns and colors, audible alerts, relay outputs, Email alerts, SMS alerts, and TCP/IP socket alerts.

5. Sensor shall permit configuration of user accounts, network parameters, SMTP connection parameters with built in test function.

n. API support

1. The sensor shall be fully supported by an API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

o. Installation and maintenance

1. The sensor shall provide built-in means which allows the assignment of IP addresses, upgrade of firmware and backup of the sensor' configuration without use of external software.
2. The sensor shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the sensor' configuration.
3. Sensor shall provide means to restore configuration with selection of desired sections of configuration to be restored.
4. The sensor shall allow updates of the software (firmware) over the network, using FTP, HTTP, or HTTPS.
5. Sensor shall provide logging and means to download daily files of Events, System States, and System Operation.
6. The sensor shall accept external time synchronization from an NTP (Network Time Protocol) server.
7. The sensor shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
8. Sensor shall provide a built-in complete system test that can be performed at any time.

p. Hardware interfaces

1. Network interface
    a. The sensor shall be equipped with one 10BASE-T/100BASE-TX Fast Ethernet-port using a shielded RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).

q. Enclosure

1. The sensor shall:
    a. Be manufactured with an IP30-rated, IK10 impact-resistant, polycarbonate casing.
    b. Secure the outer cover with anti-tamper TORX screws
    c. Be provided with self-locking mounting features for installation in materials up to ¾" (19MM) in thickness.

r. Power

1. Power over Ethernet IEEE 802.3af

s. Environmental

1. Operate in a temperature range of 0 °C to +50 °C (+32 °F to 122 °F).
2. Operate in a humidity range of 0–90% RH (non-condensing).

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractors or subcontractors' main resources within the project shall carry proper professional certification or training issued by the manufacturer.

B. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.

C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

D. All firmware found in products shall be the latest and most up to date provided by the manufacturer.

E. All equipment requiring users to log on using a password shall be configured with individually unique password/passwords. No system/product default passwords shall be allowed.

F. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

SECTION 31 11 00 - CLEARING AND GRUBBING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Protecting and preserving trees and vegetation designated to remain.

B. Clearing of site, including, but not limited to the removal of trees, shrubs, and vegetation which is not designated to remain, and brush, branches, logs, rock, debris, rubbish and other objectionable material from the entire project area.

C. Grubbing of site, including, but not limited to uprooting and removal of all stumps, roots, other organics, etc. to their full depth from the project area and disking to a depth of nine (9) inches.

D. Removal and legal, satisfactory disposal of all material cleared and grubbed from the site.

1.2 PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION

3.1 CONDITIONS AT SITE

A. Execute all work in an orderly and careful manner with due consideration for any and all surrounding areas, planting or structures which are to remain. Periodically, water as required to allay dust and dirt. Protect any adjacent property and improvements from damage and replace any portions damaged through this operation.

B. Coordinate and comply with the following:
   1. Geotechnical Report.
   2. Local ordinances and requirements of authorities having jurisdiction.

C. The Contractor shall take proper precautions to protect adjacent or adjoining property from damage caused by clearing and grubbing activities. All damage shall be repaired or replaced at Contractor's expense.

D. The Contractor shall be responsible for obtaining all permits required by State and local governing agencies.

3.2 DISPOSAL OF MATERIAL

A. All cleared and grubbed material becomes the property of the Contractor and shall legally and satisfactorily be removed and disposed of off-site. **On-site burning will not be permitted**.

3.3 FINAL SITE PREPARATION

A. Remove all rubbish, debris, etc., resulting from Work of this Section from the site.

B. After clearing, grubbing and discing the project site, rake and pick the entire site to remove all debris material.

END OF SECTION 31 11 00

SECTION 31 13 13.13 - WASTE MATERIAL DISPOSAL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. Waste material disposal consists of disposal of trees, brush, vegetation, rubbish and other objectionable matter from operations such as clearing and grubbing, demolition, excavation, concrete placement and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.

PART 3 - EXECUTION

3.1 DISPOSAL AREA

A. Items noted on plans to be "removed" or “disposed” will be taken completely off the site.

B. Concrete wash-out will become property of Contractor to be disposed of with other waste materials.

3.2 COMPACTION AND GRADING

A. Level off waste material to an elevation 12 inches below final grade. Place excess topsoil on waste material in a layer not less than 12 inches thick and compact to the density of the surrounding area.

END OF SECTION 31 13 13.13

SECTION 31 20 00 – EARTHWORK (UNDER PAVING AND SITE APPURTENANCES)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This section includes the furnishing of all plant, labor, equipment, materials and the performance of all operations required to complete the Earthwork indicated on the Drawings and specified herein, including the following: Clearing and Grubbing, Stripping, Excavation, Embankment, Borrow, Subgrade Preparation, Compaction and Finish Grading.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION

3.1 CLEARING & GRUBBING

A. This item shall consist of clearing the ground of all trees, brush, rubbish, and of grubbing the roadway, pavement areas, roadside ditches and/or outfall ditch right-of-way or other easements as designated within the limits of the project. The designated areas shall be cleared of stumps, brush, logs, rubbish, trees and shrubs, except such trees and shrubs and certain areas designated by the Engineer for preservation shall be carefully protected from abuse, marring or damage during construction operations. Continual parking and/or servicing of equipment under the branches of trees designated for preservation will not be permitted. Trees and shrubs designated for preservation, that must be pruned, shall be trimmed as directed by the Engineer and all exposed cuts over two (2) inches in diameter shall be treated with an approved material.

B. On areas required for paving, channel, or structural excavation, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the lower elevation of the excavation. On areas required for embankment construction, all stumps, roots, etc., shall be removed to a depth of approximately 2-feet below the existing ground surface. All holes remaining after clearing and grubbing shall be backfilled and compacted to ninety percent of Standard Proctor Density (ASTM Method D698) at a moisture content of between optimum and plus 3 percent of optimum as directed by the Engineer and the entire area bladed to prevent ponding of water and to provide drainage; except in areas to be immediately excavated, the Engineer may direct that the holes not be backfilled. On areas required for borrow sites and material sources, stumps, roots, etc., shall be removed to the complete extent necessary to prevent such objectionable matter becoming mixed with the material to be used in construction.

C. All cleared and grubbed materials shall be disposed of off site. Contractor shall be responsible for obtaining any necessary disposal permits. The Contractor shall not bury any refuse on site. No burning shall be permitted unless specifically noted and permitted by local jurisdictions.

D. No separate measurement or payment will be made for furnishing all labor, materials, permits, supervision, equipment and supplies required to complete all items of work specified for clearing and grubbing.

3.2 STRIPPING

A. Within the limits indicated, or in areas where existing grade is to be altered either by excavation or embankment, the Contractor shall strip existing topsoil to approximately 3-inches in depth, except that areas beneath foundations or structures shall be stripped to a minimum depth of 6-inches, and may be stockpiled for future use or disposed of at the Contractor's expense. Stripping shall include the removal and disposal of scrap iron, rubbish, logs, abandoned utilities, signs, and any and all other debris, if within the project site or right-of-way, whether above or below existing grade. Stripping and excavation can take place in the same operation, provided the topmost material is suitable for use in future construction and provided it is not to be set aside for backfill or topsoil. The upper topsoil and debris to be stripped as noted above, shall be removed regardless of whether the site is to be excavated or receive embankment. Surface soil, not suitable for use in the future construction and any other unsatisfactory material shall be excavated, removed off the site and placed in designated spoil banks or shall otherwise be disposed of as directed by the Engineer in such a manner as not to create an unsightly or objectionable condition.

B. Stripping will not be paid for directly. Payment for stripping shall be subsidiary to excavation, borrow or embankment.

3.3 EXCAVATION

A. Excavation shall consist of the required excavation within the project limits, the removal and proper utilization or disposal of all excavated materials; and the constructing, shaping and finishing of all earthwork on the entire project site, in conformity with the required lines, grades and typical cross sections, and in accordance with the specification requirements herein outlined. All suitable excavated materials shall be utilized, insofar as practicable, in grading the site, uniformly widening embankment, flattening slopes, etc., or as directed by the Engineer. The Engineer will define suitable materials. Unsuitable excavation in excess of that needed for construction shall be known as waste and shall become the property of the Contractor to be disposed of by the Contractor outside the limits of the site. Unsuitable material encountered below subgrade elevation, shall be replaced with material from the excavation, or with other suitable material.

B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price, including preparing ditches, trimming of slopes, disposal of surplus materials (wastage), preparation and completion of subgrade, shoulders, roadway, any necessary hauling and the furnishing of all labor, tools, equipment and incidentals necessary to complete the work.

3.4 EMBANKMENT

A. This item shall govern for the placement and compaction of all materials obtained from the site, borrow, channels, structural and sewer excavation, including all underground utility excavation, used in the construction of project fill and/or embankment. Prior to placing any embankment, all stripping and/or clearing and grubbing operations shall have been completed on the excavation sources and areas over which the embankment is to be placed. Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly compacted by approved methods before commencing embankment construction.

B. Unless otherwise indicated on the plans, the surface of the ground of all unpaved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 4-inches. The loosened material shall be recompacted with the new embankment as hereinafter specified and shall not exceed 8-inches in total depth. Where indicated on the plans or as directed by the Engineer, the surface of a hillside to receive embankment shall be loosened by scarifying or plowing to a depth of not less than 4 inches, or cut into steps, benched or notched before embankment materials are placed. The embankment shall then be placed in layers, not to exceed

8-inches, as hereinafter specified, beginning at the low side in part width layers and increasing the widths as the embankment is raised. The material, which has been loosened, shall be recompacted simultaneously with the embankment material placed at the same elevation. Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 4-inches and the embankment built up in successive layers, as hereinafter specified to the level of the old roadbed before its height is increased. The top of the old roadbed shall be scarified and recompacted with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible depth of layer.

C. Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in the embankment.

D. Except as otherwise required by the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the site or paving. Embankments shall be constructed to the grade established by the Engineer and completed embankments shall correspond to the general shape of the typical sections shown on the plans and each section of the embankment shall correspond to the detailed section or slopes established by the Engineer. After completion, the site shall be continuously maintained to its finished section and grade until the project is completed.

E. No material placed in the embankment by dumping in a pile or windrow shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods. Clods or lumps of material shall be broken, and the embankment material mixed by blading, harrowing, discing, or similar methods to the end that a uniform material is secured in each layer. Water required for sprinkling to bring the material to the moisture content necessary for maximum compaction shall be evenly applied and it shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.

F. After each layer of embankment or select material is complete, the Engineer will make tests as necessary. If the material fails to meet the density specified, the course shall be reworked, as necessary, to obtain the specified compaction. Should the subgrade, due to any reason or cause, lose the required stability, density or finish before the pavement is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent layer of asphaltic or other approved material. Embankment shall not be paid for directly, but shall be incidental to site excavation, channel excavation, construction of underground utilities, including all sewers, or borrow.

3.5 BORROW

A. Borrow shall consist of the required excavation, removal and proper utilization of materials secured from sources obtained by the Contractor and approved by the Engineer. Borrow shall be used only when shown on the bid form or directed by the Engineer and then only from approved sources. Borrow material shall come only from sources approved by the Engineer. The Engineer shall provide samples of the fill material for testing and approval. In the event the material is not acceptable, as determined by the Engineer, the Contractor shall find other sources. All fill material shall be free from organic matter and deleterious material.

B. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price. All work performed as required herein shall be full compensation for furnishing all labor, for all materials, for all royalties and freight involved, for all hauling, delivery, spreading and compacting complete and in place and for all tools, equipment and incidentals necessary to complete the work.

3.6 SUBGRADE

A. The subgrade shall be brought to the lines, grades and typical cross section shown on the plans and in accordance with these specifications. Whenever unsuitable natural material is encountered and cannot be handled by the excavation or embankment requirements, then the following requirements shall apply. The unsuitable material shall be excavated to a depth deemed sufficient by the Engineer and the excavated material shall be disposed of off the jobsite at the expense of the Contractor. The excavated area shall be filled to its original level with suitable material meeting the requirements of borrow. This imported material shall be compacted to 95-percent of standard proctor density, (ASTM Method D698) using a moisture content ranging from optimum to plus 3-percent above optimum. Soils shall not be compacted at less than the optimum moisture content.

B. After all holes and depressions are filled with approved material, the subgrade shall be brought up to the lines and grades required and if it is not to be stabilized, it shall be compacted to 95-percent of standard proctor density, (ASTM Method D698), using a moisture content ranging from optimum to plus 3-percent above optimum. The subgrade, without stabilization, shall be compacted to a depth of 9-inches. The subgrade shall be kept free from all ruts and weak spots. Any ruts and weak spots that develop under traffic shall be repaired with suitable material as they develop.

3.7 COMPACTION

A. All fill material shall be placed in uniform layers, dried or moistened as required to obtain approximate optimum moisture content and rolled to a density of at least 95 percent of maximum density at optimum moisture as determined by ASTM D-698. Compaction equipment shall be as hereinafter specified. The maximum thickness of uniform layers (loose measurements) shall be as follows:
   1. If the Contractor elects to use a pneumatic tired roller, the thickness of each uniform layer shall not exceed six (6) inches.
   2. If the Contractor elects to use sheepsfoot rollers, the thickness of each uniform layer shall not exceed eight (8) inches.
   3. In locations where it is impractical to use the roller equipment, mechanical hand tampers will be used, and the thickness of each uniform layer shall not exceed four (4) inches. The method used to secure the optimum moisture content will be the Contractor's responsibility. The compacting equipment and the method of compaction shall be such that a uniform density will be obtained over the entire area and depth of material being compacted. All fill material deposited in place by means of scrapers, dump trucks, draglines or other similar equipment shall be thoroughly broken up before being spread into the uniform layers. Rolling shall start longitudinally at the sides and proceed toward the center of the crowned sections or start longitudinally at the low side and proceed toward the high side of sloped areas, overlapping on successive trips by at least one-half (1/2) the width of the roller unit. Alternate trips of the roller shall be slightly different in length.

B. Excess loss of moisture shall be construed to exist when the soil moisture content is three (3) percent less than optimum moisture.

C. An independent qualified Testing Laboratory either selected by or approved by the Owner or Engineer, for every 500 square yards of the compacted subgrade shall take density tests. The Testing Laboratory will furnish written reports covering results of all tests and inspections made. Reports will be made promptly to the Engineer, Contractor and Owner.

3.8 FINISH GRADING

A. Uniformly smooth grade all areas indicated on the drawings to be graded. The finish surface shall be not more than 0.05 feet above or below the established grade or approved cross section. All ditches and swales shall be properly graded so as to drain readily. Where existing grade is

disturbed by the Contractor in areas not marked to be graded, the Contractor will regrade the disturbed area to its original grade at no additional expense to the Owner.

END OF SECTION 31 20 00

SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section shall govern for all excavation required for the construction of sewers, sewer structures, pipe culverts, appurtenances and connections and for the backfilling around completed sewers to the level of the original ground, all in conformity with the locations, lines and grades shown on the plans or as given by the Engineer and in accordance with these specifications. This Section shall also govern for any necessary pumping or bailing and drainage and all sheathing and bracing of trench walls. Also governed by this Section are the cutting and restoration of pavement and base courses, the furnishing and placing of cement stabilized backfill, the hauling and disposing of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access as provided herein.

1.2 QUALITY ASSURANCE

A. The Testing Laboratory's representative will determine the moisture density relationship in accordance with ASTM D698 on material secured from the trench excavation. Samples secured from the cement stabilized sand supplier shall be blended with Portland cement in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill, and the moisture density relationship will be determined in accordance with ASTM D558.

B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least one test for each 200 linear feet of trench per lift of backfill.

C. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, all segments shall be video tape recorded and tapes shall be furnished to the owner.

1.3 REQUIRED INSPECTIONS

A. The contractor is solely responsible for meeting with all inspecting authorities having jurisdiction over the project (to include, but not limited to: Water District, City, County, State and Federal) prior to construction. All required inspections shall be coordinated by the contractor prior to installation of the WORK. All WORK found to be deficient by the inspector(s) and WORK installed prior to notification of inspector(s) shall be removed and replaced at the contractor's sole expense.

PART 2 – PRODUCTS

2.1 CONNECTIONS TO BUILDING GRAVITY SEWERS

A. Connections to building gravity sewers, to include roof drains and sanitary sewer connections shall be made with SCH 40 X SDR adapter couplings.

B. Fernco couplers are not allowed.

PART 3 – EXECUTION

3.1 EXCAVATION & TRENCH PREPARATION

A. Excavate trench to the alignment and depth required. Brace the trench and drain, as required, so that the work may be accomplished safely and efficiently. If necessary, install a dewatering system to provide a dry trench bottom. Pumps shall discharge into natural drainage channels or to drains. Shoring for excavations and trenches shall meet the requirements of the latest edition of OSHA Regulation 1926, Subpart P.

B. For pipes less than 30 inches in diameter, the minimum width of the trench shall be the width of the outside barrel of the pipe plus 24 inches, the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches. For pipe 30 inches and larger, the minimum trench width shall be the width of the outside barrel of the pipe plus 32 inches, and the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches.

C. Side sloping or benching of the trench, where permitted, will begin at one foot above the top of the pipe and will not encroach upon private property or endanger existing or future structures or underground utilities. Depth of trench, without sheathing or bracing shall comply with OSHA Regulation 1926.650.

D. The full width of the trench shall be excavated to a depth below the invert elevation of the pipe so as to permit placing the bedding material specified on the attached drawings below the outside bottom of the pipe. Any additional depth excavated by the Contractor shall be replaced with an equal depth of cement-stabilized sand. The cost of this additional material, in place shall be at the expense of the Contractor.

E. Where necessary, excavations shall have sheathing and bracing to prevent caving. At these locations, increase the trench width as required and leave the sheathing in place until the pipe has been laid and the backfill compacted to a depth of 2 feet over the pipe. All sheathing and bracing shall be designed to the requirements of OSHA Standard 1926, Subpart P (latest edition).

F. Sewers shall not be constructed, or sewer pipe laid in the presence of water. All water shall be removed from the excavation sufficiently prior to the sewer placing operation to ensure a dry, firm bed on which to place the sewer and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point system as conditions warrant. There will be no separate pay for well pointing without the prior approval of the Engineer. Contractor shall include in base proposal all costs associated with de-watering, well pointing, stabilizing, etc. necessary to install all underground utilities.

G. In the event that the excavation cannot be dewatered to the point where the pipe subgrade is free of mud, excessive wet soil, sand silt or clay with water, a seal slab shall be used in the bottom of the excavation. Such seal slab shall consist of a lean concrete mixture. The seal slab shall be a Class “D”, 5 sacks of cement per cubic yard with a minimum compressive strength of 1,750 P.S.I. at 7 days and 2,500 P.S.I. at 28 days. A precast seal slab may be used, provided that the joints of the seal slab do not occur at the joint of the pipe. Contractor shall have an option of using a three-day cylinder break test at no expense to the Owner.

H. For unstable conditions requiring outside forms, seals, sheathing, and bracing, or where groundwater is encountered, any additional excavation in width and backfill required shall be done at the Contractor’s expense. Portable trench boxes may be used in lieu of sheathing upon approval in writing by the Engineer. The trench box must be in accordance with OSHA Regulation 1926.650 (latest edition).

I. Use of the trench box does not relieve the Contractor of any liability for damages to person or property. When a trench box is moved, the jointed pipe or in-place backfill shall not be disturbed.

J. All materials from excavation operations not required for backfilling, if considered suitable shall be placed in embankments or wasted, in accordance with Section 31 20 00 - Earthwork. All material not suitable for use in embankments will be declared surplus by the Engineer and shall become the responsibility of the Contractor to dispose of as he wishes. Such surplus material shall be promptly removed from the work following the completion of the portion of the sewer involved. No separate payment shall be made for disposal of this surplus material.

K. Unless otherwise specifically approved, Contractor shall use ladder or wheel-type trench-digging machinery, except where hand methods must be employed to avoid damage to existing structures above or below ground, or where hand excavation is indicated.

L. Engineer may limit the amount of trench opened or partially opened at any time in advance of the completed pipe laying operation and the amount of trench left unfilled. Open no more than 500 feet of trench at any one time.

3.2 PIPE LAYING

A. No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work, unless specifically approved by the Engineer.

B. Non-pressure concrete pipe shall be laid with the ends abutting and true to line and grade. Fit and lay the pipe to form a smooth and uniform invert. Laying of pipe shall commence at the lowest point, so that the spigot ends point in the direction of flow. Lay cast iron pipe on firm earthen foundation with bell ends facing the direction of laying.

C. All other types of pipe shall be laid in accordance with the applicable provisions of this specification, in accordance with the Special Provisions preceding this Subsection, or with the manufacturer’s recommendations.

D. Cut cast iron pipe with wheel-type cutters or cold chisel. Flame cutting of cast iron pipe is not allowed. Make cuts in a neat and workmanlike manner without damage to pipe and so as to leave a smooth end at right angles to axis of pipe. Field cutting of Polyvinyl Chloride shall be in accordance with the pipe manufacturer's recommendations.

E. Minor deflections may be obtained in pipe joints. Contractor must obtain approval when the degree of deflection is necessary to deflect from a straight line. Where necessary to make major deflections in concrete pipe, use sections of pipe with beveled ends for deflections not greater than five degrees. For deflections greater than five degrees, use fabricated fittings for concrete pressure pipe and use cast iron fittings for cast iron pipe.

F. When the pipe laying operation is halted, seal the open end of the pipe with a temporary plug. Plug is to remain in place until the pipe laying operation re-commences. Standard plugs shall be inserted into bells of all dead-end pipe.

G. All underground pipe shall have a 12-gauge metallic tracer wire running the full length of the pipe. Tracer wire shall be taped to the pipe at intervals not to exceed 15-feet using duct tape and terminate at each end above ground in a 2” PVC riser.

H. Pipe shall be installed with the labels facing upward.

I. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm

and sanitary sewer lines, contractor shall run video-camera through pipes and video-record each line segment in order to document proper installation.

3.3 BACKFILLING

A. As soon as practicable after completion of laying and jointing of pipe, backfill the trench. Not more than 200 feet of the trench shall be left open after laying the pipe.

B. Trenches shall be backfilled in accordance with drawing details and notes. Backfill material selected from sewer trench excavation, or obtained from other sources, shall be free from stones, which will interfere with compaction and free of large lumps, which will not break down readily under compaction. Do not use material excavated in large lumps which will not break down or which cannot be spread in loose layers. Material excavated by trenching machine will generally be suitable for use as backfill. Cement stabilized sand shall be in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill.

C. When placing backfill in the trench simultaneously on both sides of the pipe for the full width of the trench, moisten if necessary and tamp in approximately 6-inch layers, thoroughly compacting under and on each side of the pipe to provide solid backing against the external surface of the pipe. Walking or working on the completed pipeline, except as necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to at least 12-inches over the top of the pipe.

3.4 RESTORATION OF SURFACES

A. Replace or repair sidewalks, driveway culverts, inlets, curbing, gutters, shrubbery, trees, fences, sod and other like obstructions removed or disturbed, to the condition equivalent to that existing prior to commencement of this work. Use concrete having a compressive strength of not less than 3,000 psi in 28 days for the replacement of curbing, gutters, inlets and sidewalks.

B. Use reasonable care in the removal and replacement of shrubbery and trees designated to be replaced at original locations. Where at all possible, ditch alignment will be such as to minimize this work. The restoration of asphalt-topped flexible base and concrete streets shall be as specified under other items of the specifications.

3.5 CLEAN-UP

A. The Contractor shall remove from the site of the work and from public and private property temporary structures, rubbish, and waste materials, including excess excavated materials. The Contractor is responsible for disposing of all surplus earth. The pipe laying operation shall be temporarily suspended if the clean-up is falling behind as determined by the Engineer or Owner.

3.6 MEASUREMENT & PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 00

SECTION 31 23 23.13 - BANK SAND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section shall consist of the furnishing, placing, manipulation, compacting and completing in-place, Bank Sand as a bedding and backfill material for water and sewer lines, as construction fill for certain excavation areas, as construction fill for ruts, holes and other similar conditions; as a fill material for project clean-up and as directed by the Engineer. Bank sand shall be in accordance with these specifications and in conformity with the lines, grades and cross-sections shown on the plans and as directed by the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Bank sand is to be free of organic matter, foreign material, clay balls, sticks, foreign objects and other objectionable material. Bank sand shall have a plasticity index less than three (3) and shall meet the following gradation: 100 percent passing a 3/8-inch sieve, 5 to 30 percent passing a No. 200 sieve. Prior to use, Contractor shall identify the source of the proposed bank sand for testing.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. After the water line, sewer line or other similar construction item, such as a trench, has been excavated and brought to grade, bank sand shall be furnished, placed, compacted complete in-place, either as bedding or backfill material, as shown on the plans, described in these specifications or as directed by the Engineer. After the trench or excavation has been brought to grade, the bank sand shall be placed and compacted as a bedding material, the construction item shall be placed and joined properly around and over that construction item as required and as shown on the plans, described in the specifications or directed by the Engineer. Bank sand shall be placed in layers not exceeding 8-inches. It shall be compacted with mechanical vibratory tamps to maximum dry density in accordance with ASTM Method D698 at a moisture content ranging from optimum to three percentage points above optimum. Water flooding will not be permitted.

3.2 TESTING

A. The Testing Laboratory’s representative will determine the moisture density relationship for each material proposed for use as backfill, in accordance with ASTM Method D698. In place density will be determined in accordance with ASTM Methods D2922 or D1556, and with each type of construction. For walls and trenches, determine the in-place density for each 200 feet of wall or trench, for each lift of fill placed.

3.3 MEASUREMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 23.13

SECTION 31 23 23.16 - CEMENT STABILIZED SAND BEDDING AND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies cement stabilized sand to be used for backfilling and bedding as called for on the drawings, in other parts of the specifications, or as directed by the Engineer.

1.2 PERFORMANCE

A. The sand cement mixtures shall produce a minimum unconfined compressive strength of one hundred pounds per square inch (100 psi) in forty eight hours, when compacted to ninety five percent (95%) of Standard Proctor density (ASTM Method D558), without additional moisture control and when cured in plastic bags at a temperature of 73.4º F at plus or minus 3º F and tested in accordance with ASTM D1633.

B. Random samples of the delivered product will be taken in the field at the direction of the Engineer and tested at the Owners expense.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement shall be Type I Portland cement conforming to ASTM C150. Sand shall be clean durable sand containing not more than the following:
   1. Deleterious Materials:
      a. Clay lumps, when tested in accordance with ASTM C142 shall be less than 0.5 percent. Lightweight pieces, when tested in accordance with ASTM C123 shall be less than 5.0 percent. Organic impurities when tested in accordance with ASTM C40 shall not show a color darker than the standard color.
   2. The plasticity index shall be six (6) or less when tested in accordance with ASTM D4318.
   3. Sand shall be free of organic matter and deleterious substances and shall meet the following gradation requirement.

Square Sieve Size	% Passing, By Weight
3/8"	100%
No. 200	5 - 30%

   4. Water shall be clean and clear, free of oils, acids, alkalis, organic matter or other deleterious substances and shall conform to the requirements of ASTM C1602.

2.2 SAND-CEMENT MIXTURE PRODUCT

A. The mixture shall consist of not less than 1.5 sacks of Portland cement per cubic yard (1.1 sacks per ton) of material mixture as placed. The mixture shall contain sufficient water to hydrate the cement.

B. The cement, sand and water shall be mixed in a pug mill type mixer, which meets the approval of the Engineer. It shall be mixed for a minimum period of two minutes per batch.

PART 3 – EXECUTION

3.1 APPLICATION

A. The sand cement mixture shall be placed in maximum eight (8) inch thick lifts, loose measure, and thoroughly rodded and tamped around the pipe, boxes, structures, and paving sections. Placement and compaction shall be performed in a manner that will thoroughly fill all voids without placing undue strain on or displacement of the structure.

B. Cement stabilized sand backfill below the top of sewers, manholes, inlets or other structures shall be placed equally along all sides of the structure. Cement stabilized sand backfill/bedding shall be placed in a manner that will completely fill all voids in the trench. Should compaction be required to fill all voids in the areas described, hand operated tampers may be used.

C. Materials not placed and compacted within four (4) hours after mixing shall be rejected. Do not place or compact sand-cement mixtures in standing or free water.

D. Cement stabilized sand backfill/bedding that is placed in trench bottoms or all other locations between the tops of sewer lines to the bottom of the subgrade, shall be compacted to a minimum of ninety five percent (95%) of Standard Proctor Density (ASTM Method D558), and shall apply to all areas of construction within the limits of the project.

E. In-place density tests shall be taken at each location, each day, to test the placement of bedding/backfill material as directed by the Engineer. In-place densities shall be determined in accordance with ASTM D6938 or ASTM D1556.

END OF SECTION 31 23 23.16

SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This item shall consist of treating the subgrade, by the pulverizing, addition of lime, mixing and compacting the mixed material to the required depth and density, and in the amounts shown on the plans.

B. This item applies to natural ground, embankment, base or sub-base and shall be constructed to the sections, lines and grades shown on the plans. The subgrade shall be stabilized with lime to a depth of at least 6-inches in the amount recommended by a materials engineering laboratory. The P.I. shall be determined by ASTM Method D4318.

1.2 QUALITY ASSURANCE

A. The Testing Laboratory's representative will determine the Moisture-Density Relationships in accordance with ASTM Method D698 on material secured from the roadway after stabilization with lime, for each type of material encountered.

B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests for each 1,000 feet per lane of roadway or 4,000 square feet (500 square yards) of embankment.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Lime for stabilization shall be classified as Type A- Hydrated Lime, or Type B- Commercial Lime Slurry, conforming to the requirements of Section 31 32 13.20 - Hydrated Lime and Lime Slurry.

2.2 EQUIPMENT

A. The machinery, tools and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform lime soil mixture free from loose or segregated areas, of uniform density and

moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

B. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.

C. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.

D. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day. The application and mixing of lime with the material shall be accomplished by the methods hereinafter described as "Dry Placing" or "Slurry Placing". When Type A, Hydrated Lime, is specified, the Contractor may use either method, unless otherwise noted on the plans.

E. When dry placing, the lime shall be spread by an approved spreader or by bag distribution at the rates shown on the Bid Sheet, or as directed by the Engineer.

F. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime.

G. The material shall be sprinkled as directed by the Engineer, until the proper moisture content has been secured. Where Type A, hydrated lime is specified and slurry placement is used, the Type A hydrate shall be mixed with water to form a slurry of the solids content designated by the Engineer. A minimum of two mixing passes will be required.

H. Where Type B, commercial lime slurry is to be used, it shall be of the minimum solids and purity for the applicable grade being used. The distribution of lime shall be at the rates shown on the proposal form, or as directed by the Engineer. Proper application shall be attained by successive passes over a measured section of the roadway, until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.

I. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until, in the opinion of the Engineer, a homogenous friable mixture of material and lime is obtained, such that when all non-slaking aggregates retained on the 3/4-inch sieve are removed, the remainder of the material shall meet the following requirements when tested in accordance with ASTM Method C136, from samples procured from the roadway.

TABLE I

Minimum Passing 1 3/4" sieve	100 Percent
Minimum Passing 3/4" sieve	85 Percent

J. If gradation is achieved on the first mixing, no additional mixing is required.

K. The soil lime mixture shall be sprinkled during the mixing operation as directed by the Engineer to provide optimum moisture in the mixing. The subgrade shall be stabilized to a minimum depth of

6-inches and compacted to a minimum of 95-percent of standard proctor density (ASTM D698) at a moisture content of optimum to 3-percent above optimum.

L. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours, or more, or has had excessive loss due to washing or blowing will not be accepted for payment.

M. Compaction of the mixture shall begin immediately after final mixing unless approval has been obtained from the Engineer not to do so. The material shall be aerated and/or sprinkled as necessary, to provide the optimum moisture content. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted.

N. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until, in the opinion of the Engineer, a homogenous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clays or other materials which will not readily mix with lime shall be mixed as thoroughly as possible at the time of lime application, brought up to the proper moisture content and left to cure 48 to 96, hours as directed by the Engineer. During the curing period the material shall be kept moist as directed.

O. If a second mixing is required, the material shall be given a final mixing, using approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying, or the use of other approved pulverization methods, so that all non-slaking material retained on the 3/4-inch sieve is removed and the remainder of the material shall meet the gradation requirements outlined by Table I. After the second mixing has been completed, the material shall be allowed to cure for a minimum of 3 days, unless otherwise directed by the Engineer.

P. The material shall be sprinkled and rolled, as directed by the Engineer. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and re-compacting by sprinkling and rolling. The surface of the course shall be maintained and cured for a minimum of 3 days, prior to placing a base or surface course or until traffic is allowed to travel thereon.

Q. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed and refinished at the expense of the Contractor.

3.2 FINISHING

A. After the final course of the lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist, or emulsion cured until covered by base material, unless otherwise directed by the Engineer. If the plans provide for the treated material to be sealed or covered by other courses of material, such seal or course shall be applied within 14 days after final mixing and compaction is completed, unless otherwise directed by the Engineer.

END OF SECTION 31 32 13.19

SECTION 31 32 13.20 - HYDRATED LIME AND LIME SLURRY

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section establishes the requirements for hydrated lime and commercial lime slurry of the type and grade considered suitable for use in the treatment of natural or processed materials or mixtures for subgrade, sub-base and base construction.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The various types and grades are defined and identified as follows:
   1. Type A, Hydrated Lime: Shall consist of a dry powder obtained by treating quicklime with enough water to satisfy its chemical affinity for water under the conditions of its hydration. This material is to consist essentially of calcium hydroxide or a mixture of calcium hydroxide and a small allowable percentage of calcium oxide, magnesium oxide and magnesium hydroxide. Hydrated lime shall meet the requirements of ASTM Designation.
      a. When sampled and tested according to prescribed Texas Highway Department procedures, hydrated lime shall conform to the following requirements as to chemical composition:
         1) Hydrate alkalinity, percent by weight CA (OH)2 Min. 90.0%
         2) Unhydrated lime content, percent by weight CaO Max. 5.0%
         3) "Free Water" content, percent by weight H 2 0 Max. 4.0%

      b. The percent by weight of residue retained shall conform to the following requirements:
         1) Residue retained on a No. 6 sieve Max. 0.0%
         2) Residue retained on a No. 10 sieve Max. 1.0%
         3) Residue retained on a No. 30 sieve Max. 2.5%

      c. Specifications for Type "A" applies specifically to the normal hydrate of lime made from "high-calcium" type limestone. Hydrated Lime for stabilization purposes shall be applied, as provided in the governing specifications, as a dry powder or mixed with water to form a slurry.

   2. Type B, Commercial Lime Slurry: Shall be pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition, residue and delivered in trucks which shall be equipped with an agitator which will keep the lime and water in a uniform mixture.

a. Chemical Composition: The "solids content" of the lime slurry shall have a hydrate alkalinity Ca (OH)2 of not less than 90% by weight.
b. Residue: The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:
   1) Residue retained on a No. 6 sieve Max. 0.0%
   2) Residue retained on a No. 10 sieve Max. 1.0%
   3) Residue retained on a No. 30 sieve Max. 2.5%

c. Type B: Commercial Lime Slurry shall conform to one of the following grades:
   1) Grade 1: The "Dry Solids Contents", shall be at least 31 percent by weight of the slurry.
   2) Grade 2: The "Dry Solids Contents", shall be at least 35 percent by weight of the slurry.
   3) Grade 3: The "Dry Solids Contents", shall be at least 46 percent by weight.

PART 3 – EXECUTION

3.1 SAMPLING AND TESTING

A. The sampling and testing of lime slurry shall be as determined by Test Method Tex-600-J, "Lime Testing Procedure".
   1. When Type A: Hydrated Lime is used, the quantity of lime will be measured by the ton of 2000 pounds, dry weight.
   2. When Type B: Commercial Lime slurry, is used, the quantity of lime shall be calculated from the required minimum percent solids based upon the use of Grade 1, Grade 2, or Grade 3 as follows:
      a. Grade 1: The "Dry Solids Content" shall be at least 31 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2000 pounds based on the 31 percent dry weight solids.
      b. Grade 2: The "Dry Solids Content" shall be at least 35 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2000 pounds based on the 35 percent dry weight solids.
      c. Grade 3: The "Dry Solids Content" shall be at least 46 percent by weight of the slurry and the quantity of lime will be calculated by the ton of 2,000 pounds based on the 46 percent dry weight solids.

END OF SECTION 31 32 13.20

SECTION 31 32 13.21 - LIME-FLYASH STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This item shall consist of treating the subgrade by the pulverizing, addition of lime flyash and/or flyash, mixing and compacting the mixed material to the required density. This item applies to natural ground and embankment and shall be constructed as specified herein and in conformity with the typical sections, lines and grades shown on the Plans.

1.2 QUALITY ASSURANCE

A. The Materials Engineer will determine the Moisture-Density Relationship in accordance with ASTM Method D698, on material secured from the roadway. Samples shall be blended with Lime-Flyash in the laboratory for each type of material encountered.

B. The Materials Engineer will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests of 4,000 square feet (500 square yards) of subgrade.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Hydrated lime shall meet the requirements of ASTM C977 and SECTION 31 32 13.20 – HYDRATED LIME AND LIME SLURRY of these Specifications. When Type B, commercial lime slurry, is specified, the Contractor shall select, prior to construction, the grade to be used and shall notify the Engineer in writing before changing from one grade to another.

B. Flyash shall meet the requirements of ASTM C618, Class C. Flyash shall also have a minimum CaO content of 20 percent.

C. Water shall meet the requirements of ASTM Designation C94.

2.2 EQUIPMENT

A. Machinery, tools and equipment for proper performance of the work shall be on the Project and approved by the Engineer prior to the beginning of construction operations.

B. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

C. Hydrated lime and flyash shall be stored and handled in closed, weatherproof containers until immediately before distribution on the subgrade. If storage bins are used, they shall be completely

enclosed. Materials in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.

D. If lime and/or flyash are furnished in trucks, each truck shall have a weight ticket from a certified scale.

E. If lime and/or flyash are furnished in bags, each bag shall bear the manufacturer's certified weight. Bags varying more than five percent from that weight may be rejected and the average weight of the bags in any shipment, as shown by weighing 50 bags taken at random, shall not be less than the manufacturer's certified weight.

PART 3 – PRODUCTS

3.1 CONSTRUCTION METHODS

A. It is the primary requirement of this Specification to secure a complete course of treated material containing a uniform lime-flyash or flyash mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface and suitable for placing subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime and flyash, maintain the work and rework the courses as necessary to meet the above requirements.

B. Before other operations are begun, the subgrade shall be graded, shaped, and compacted as required to construct the lime-flyash or flyash treatment for materials in-place in conformance with the lines, grades, thickness and typical cross sections shown on the Plans. Unsuitable soil or material shall be removed and replaced with acceptable material.

C. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime and/or fly ash, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.

D. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.

E. The Contractor shall be required to use a cutting and pulverizing machine that will remove the subgrade material accurately to the secondary subgrade; and pulverize the material at the same time. He will not be required to expose the secondary grade nor windrow the material. However, the Contractor shall be required to roll the subgrade, before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which will ensure that the material is cut uniformly to the proper depth and which has cutters that will plane the secondary grade to a smooth surface over the entire width of the cut.

F. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this item.

G. When lime-flyash stabilization is required it shall be a two-phase operation, with the lime placed and allowed to cure, before the flyash stabilization begins.

H. Application of the lime and the subsequent curing shall be in accordance with SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE. After the subgrade has cured for the time required by that

Specification, then flyash stabilization may begin. Flyash stabilization shall be in accordance with this Specification. Unless otherwise noted, the thickness of stabilization shall be 6-inches.

I. The machine will be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.

J. Lime shall be spread only on that area where the first mixing operation can be completed during the same working day.

K. The sequence of application of lime and flyash, with the material, shall be accomplished by the methods hereinafter described as "Dry Placing", or "Slurry Placing". When Type A, hydrated lime is specified, the Contractor may use either method.

L. The lime or flyash shall be spread by a spreader or by bag distribution at the rate directed by the Engineer.

M. For dry placing, the lime or flyash shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime or flyash by wind to a minimum. Lime or flyash shall not be applied when wind conditions are such that blowing lime or flyash becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime or flyash.

N. The materials shall be sprinkled until the proper moisture content has been secured. However, initial mixing after the addition of lime or flyash will be accomplished dry or with a minimum of water to prevent lime and/or flyash balls.

O. For slurry placing, the lime or flyash shall be mixed with water in vehicles with approved distributors and applied as a thin water suspension or slurry.

P. Type B, commercial lime slurry, shall be applied with a lime percentage not less than that applicable for the grade used. The distribution of lime and flyash shall be attained by successive passes over a measured section of roadway until the proper moisture and lime or flyash content has been secured. The distributor vehicle shall be equipped with an agitator, which will keep the lime or flyash and water in a uniform mixture.

Q. The mixing procedure shall be the same for "Dry Placing or "Slurry Placing", as hereinafter described.

R. The material shall be uniformly mixed by approved methods. If the soil binder lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all non-slaking aggregates retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested at the field moisture condition, or dry by laboratory sieves in accordance with ASTM Method C136.

Minimum Passing 1-3/4 sieve	100 percent
Minimum Passing 3/4 sieve	85 percent

S. It is the intent of this Specification that lime and flyash shall be spread as directed by the Engineer.

T. The amount of lime and flyash used shall be as directed by the Engineer.

U. During the interval of time between application and mixing, hydrated lime or flyash that has been exposed to excessive loss due to washing or blowing will not be accepted for payment. Spreading, mixing, compaction and finishing for lime-flyash stabilized subgrade should be completed during daylight hours of the same day.

V. If flyash only is to be used without lime, the following mixing procedures shall apply.

W. The raw material shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until a homogeneous, friable mixture is obtained, free from all clods or lumps.

X. The flyash shall be distributed at a uniform rate and in such manner as to reduce the scattering of flyash by the wind to a minimum. Flyash shall not be applied when wind conditions, are such that blowing flyash becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread flyash.

Y. The material and flyash shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until a homogeneous, friable mixture of materials is obtained, free from all clods or lumps. If the soil binder-flyash mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying or the use of other approved pulverization methods so that when all nonslaking aggregates, retained on the 3/4" sieve are removed, the remainder of the material shall meet the following requirements when tested at the field moisture condition or dry by laboratory sieves using ASTM Method C136:

Minimum Passing 1-3/4 sieve	100 percent
Minimum Passing 3/4 sieve	85 percent

Z. Flyash shall be applied only to such an area that all the operations can be continuous and completed in daylight.

AA. During the interval of time between application and mixing, flyash that has been exposed to the open air for a period of 6 hours or more, or to excessive loss due to washing or blowing will not be accepted for payment. It is recommended that the mixing and compaction of flyash stabilized subgrade by completed within 2 hours in order to take advantage of rapid initial set characteristics.

BB. Mixing after the addition of flyash will be accomplished dry or with a minimum of water to prevent flyash balls.

CC. Compaction of the mixture shall begin immediately after adding and mixing of the last stabilizing agent and be completed within 6 hours. The material shall be aerated or sprinkled as necessary to provide the optimum moisture. Compaction shall begin at the bottom and shall continue until the entire depth of the mixture is uniformly compacted to 95 percent of standard proctor density (ASTM D698), to a minimum depth of 6 inches. In addition to the requirements it shall be compacted to the extent necessary to remain firm and stable under the construction equipment. Throughout the entire operation the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and in conformity with the typical section shown of the Plans and to the established lines and grades.

DD. After the final layer of the lime-flyash or flyash treated subgrade has been compacted, it shall be brought up to the required lines and grades, and in accordance with the typical sections.

EE. The resulting surface shall be thoroughly rolled with a pneumatic tire roller and skinned by a power grader to achieve final grade, removing all loosened stabilized material from the section. The surface shall be thoroughly compacted with the pneumatic roller, adding small increments of moisture as needed during rolling. If aggregate larger than a 3/4" screen is present in the mixture, one complete coverage of the section with the flat wheel roller shall be made immediately after the skinning operation. Surface finishing methods may be varied from this procedure to provide a dense, uniform surface, free of surface compaction planes. The moisture content of the surface material must be maintained at optimum during all finishing operations. Surface compaction and finishing shall proceed in such a manner as to produce, in not more than 2 hours, a smooth, closely

knit surface, free of cracks, ridges or loose material conformity to the crown, grade and line shown on the Plans.

FF. After the lime-flyash or flyash treated course has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods for a period of not less than 3 days or as directed by the Engineer.
   1. Maintain in a thorough and continuously moist condition by sprinkling.
   2. Apply an asphalt membrane to the treated course, immediately after same is completed. The asphalt material for the membrane shall be MC-30. Asphaltic material shall meet the requirements of Item 300, Oils, Asphalts and Emulsions, of the TxDOT "Standard Specifications for Construction of Highways, Streets and Bridges". The asphalt shall completely cover and seal the total surface of the base and fill all voids. If the Contractor elects to use this method, it shall be his responsibility to protect the asphalt membrane from being picked up by traffic.

GG. The asphalt membrane may remain in place when the proposed surface or other base courses are applied.

HH. Completed sections of lime-flyash or flyash treated material in-place may be opened immediately to local traffic and to construction equipment and to all traffic after the curing period, provided the lime-flyash or flyash treated course has hardened sufficiently to prevent marring or distorting the surface by equipment or traffic, and after the minimum 3 day curing period. If the Plans provide for the treated material to be sealed or covered by other courses of material such seal or course shall be applied within 14 days after compaction unless otherwise directed by the Engineer. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed, it shall be reprocessed and refinished at the expense of the Contractor.

END OF SECTION 31 32 13.21

SECTION 31 41 00 - TRENCH SAFETY SYSTEM

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. This item is for furnishing all labor and materials for installation and maintenance of a trench safety system.

B. For any trench excavation in materials other than solid rock, greater than five (5) feet in depth, or where shown on the plans, the contractor shall provide a trench safety system. This trench safety system shall be in accordance with the appropriate requirements established in the Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Subpart P - "Excavations, Trenching and Shoring" (latest edition).

1.2 MEASUREMENT

A. Measurement of the "Trench Safety System" for gravity pipelines and boxes and for pressure pipelines shall be made by the linear foot of trench measured along the centerline of the trench.

1.3 PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS
Not Used

PART 3 – EXECUTION
Not Used

END OF SECTION 31 41 00

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Sections:
1. Section 013200 "Construction Progress Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Section 015000 "Temporary Facilities and Controls" for temporary utilities and support facilities.
3. Section 312000 "Earth Moving"
4. Section 312319 "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

A. Shop Drawings: For excavation support and protection system.

B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Other Informational Submittals:
1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
   a. Note locations and capping depth of wells and well points.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
   1. Notify all impacted parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
   2. Do not proceed with interruption of utility without Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
   1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
   2. The geotechnical report is referenced elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations.
   1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Delete this article if Contractor selects temporary excavation support and protection. Revise materials if prescribing excavation support and protection system requirements.

B. General: Provide materials that are either new or in serviceable condition.

C. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
   1. Corners: Site-fabricated mechanical interlock or roll-formed corner shape with continuous interlock.

E. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

H. Tiebacks: Steel bars, ASTM A 722/A 722M.

I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
   1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
   1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.

2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
   1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
   2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
   3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
   1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
   2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
   3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 31 63 29 - DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Dry-installed drilled piers.

1.3 UNIT PRICES

A. Unit prices are included in Section 01 22 00 "Unit Prices."

B. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
   1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, extended through the bell, if applicable, and the diameter of shaft and bell.
   2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.

C. Trial Drilled Pier: Unit price as indicated for drilled pier, including backfilling.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.

D. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement and accessories.

E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

F. Field quality-control reports.

G. Other Informational Submittals:
1. Record drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
1. Notify all affected parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
2. The geotechnical report is referenced elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Refer Section 03 20 00.

2.2 CONCRETE MATERIALS

A. Refer Section 03 30 00 and Structural General Notes.

2.3 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283, Grade C, or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.

B. Corrugated-Steel Pipe Casings: ASTM A 929, steel sheet, zinc coated.

2.4 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.

C. Proportion normal-weight concrete mixture as follows:
   1. As indicated in Structural General Notes.

2.5 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
   1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.
   2. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power,

torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
2. Remove water from excavated shafts before concreting.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

G. Bells: Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before placing concrete.

H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

3.3 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
   1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
   1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
   2. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
   1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
   1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Drilled piers.
   2. Excavation.
   3. Concrete.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
   1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.

D. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94.
   1. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.

2. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F and below and 80 deg F and above, and 1 test for each set of compressive-strength specimens.
3. Compression Test Specimens: ASTM C 31; one set of four standard 6-inch x 12-inch cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
4. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier but not more than one set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.
5. If frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency will make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.
    a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:
1. Actual top and bottom elevations.
2. Actual drilled-pier diameter at top, bottom, and bell.
3. Top of rock elevation.
4. Description of soil materials.
5. Description, location, and dimensions of obstructions.
6. Final top centerline location and deviations from requirements.
7. Variation of shaft from plumb.
8. Shaft excavating method.
9. Design and tested bearing capacity of bottom.
10. Levelness of bottom and adequacy of cleanout.

11. Ground-water conditions and water-infiltration rate, depth, and pumping.
12. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
14. Bell dimensions and variations from original design.
15. Date and time of starting and completing excavation.
16. Inspection report.
17. Condition of reinforcing steel and splices.
18. Position of reinforcing steel.
19. Concrete placing method, including elevation of consolidation and delays.
20. Elevation of concrete during removal of casings.
21. Locations of construction joints.
22. Concrete volume.
23. Concrete testing results.
24. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

SECTION 32 05 19.18 - PVC - GEOMEMBRANE LINER FOR TURF SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The GEOSYNTHETICS CONTRACTOR shall furnish all labor, materials, equipment, tools, and appurtenances required to complete the installation of all geomembranes, complete with appurtenances, as shown, specified or required by the Drawings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. D 618 Conditioning
2. D 751 Hydrostatic Burst Test, Section 33, Procedure A
3. D 792 Specific Gravity
4. D 882 Tensile Properties
5. D 1004 Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting
6. D 1203 Volatile Loss
7. D 1204 Dimensional Stability
8. D 1239 Water Extraction
9. D 1790 Low Temperature Impact
10. D 4354-99 Standard Practice for Sampling of Geosynthetics for Testing
11. D 4551 PVC Plastic Concealed Water Containment Membrane
12. D 4873-01 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
13. D 5199-01 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
14. D 5321-92 (1997) Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
15. D 5820-95 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
16. D 6214 Chemical Seam Evaluation
17. D 6243-98 Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
18. D 6392-99 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
19. D 7176 Standard Specification for Non-Reinforced Polyvinyl Chloride (PVC) Geomembranes used in Buried Applications.
20. D 7177 Standard Specification for Air Channel Evaluation of Polyvinyl Chloride (PVC) Dual Track Seamed Geomembranes

B. Environmental Protection, Inc.
1. Quality Control Manual for Fabrication and Installation of PVC Geomembranes. January 1, 2006.

C. The most current version of the specified test method shall be followed by the MANUFACTURER, GEOSYNTHETICS CONTRACTOR or authorized testing laboratory.

1.3 DEFINITIONS

A. Minimum Value – Property value representing the lowest individual allowable value obtained when tested according to the specified test method. This applies to individual readings, such as thickness; or where only one specimen is tested for the specified parameter.

B. Minimum Average Value – Property value representing the lowest allowable value for the average of results for the specimens tested.

C. Nominal Value – Property value that is representative of a measurable property, determined under a set of prescribed test conditions, by which a product may be described.

D. Lot - For the purposes of this project, a “Lot” will be defined as a single run of geosynthetic material from the same production facility, where the tooling and raw materials of production have not changed during manufacturing.

E. Roll - A quantity geomembrane rolled up to form a single package as supplied from the manufacturer

F. Sheet - A part of the manufacture’s geomembrane material cut from the roll.

G. Panel - A series of geomembrane sheets fabricated together to make a larger unit, as supplied by a fabricator usually folded onto a pallet or folded then rolled on a core.

H. Manufacturer - A company that takes raw materials and calendars or extrudes them into geomembrane rolls

I. Fabricator - a company that converts geomembrane rolls into panels

J. Installer - a company that installs PVC geomembrane panels in field applications.

1.4 SUBMITTALS

A. The GEOSYNTHETICS CONTRACTOR shall submit to the ENGINEER all items included in this Article. Submittals shall be provided as follows:
   1. With the GEOSYNTHETICS CONTRACTOR’s BID:
      a. A project reference list documenting the experience of the GEOSYNTHETICS CONTRACTOR on a minimum of 5 projects consisting of at least 10 million square feet of installed PVC geomembrane.
      b. A copy of the Fabricator’s Quality Assurance/Quality Control (QA/QC) Plan for the complete geomembrane fabrication process.
      c. A schedule of operations, including means and methods of installation.
      d. The name of the fabricator of the geomembrane panels to be used for the project and the proposed method of joining adjacent geomembrane panels.

   2. At least 15 days prior to delivery of geomembrane to the site, unless otherwise noted below:
      a. Shop drawings, including proposed panel diagram and details of proposed work, pipe boots, and details of sealing around all necessary geomembrane penetrations, to be submitted at least 15 days prior to delivery of geomembrane to the site. The panel diagram must depict and/or note the planned number and orientation of panels, the panel sizes, seam orientation, placement of seams in corners, treatment of tee seams and the GEOSYNTHETICS CONTRACTOR’s preferred sequence of panel placement. The PVC panels shall be orientated in a manner that minimizes seams. The ENGINEER, prior to geomembrane installation must approve the panel diagram. The ENGINEER, in writing, prior to altering the installation, must approve proposed revisions to the panel diagram.
      b. Geomembrane - Manufacturing Quality Control (MQC) data (Material Certifications) for the geomembrane to be delivered to the site. The reports shall include the quality control test results obtained during the manufacture of the material. In the event material is delivered to the site prior to the receipt of the MQC certificates, the material without certificates will be stored separately from the

material with certificates. Material with unacceptable MQC data will be segregated from approved material and shall be marked for rejection. The geomembrane will be rejected if it is found to have defects, rips, holes, flaws, deterioration or other damage deemed unacceptable by the ENGINEER.

c. Geomembrane Sample - Samples of the proposed geomembrane shall be sent to the OWNER for interface shear testing within 5 days after the OWNER makes such request. The GEOSYNTHETICS CONTRACTOR shall coordinate the quantity and dimensions of the samples with the OWNER.

3. At least 15 days prior to installation:
   a. Resumes of geomembrane crew; including, Supervisor, QC Manager, and Master Seamer. The resumes shall include prior experience in installing PVC geomembrane. Individual geomembrane crew members will be subject to the approval of the ENGINEER and OWNER.
   b. A copy of the GEOSYNTHETICS CONTRACTOR's standard operating procedure (SOP) for operating an ATV on site, particularly with respect to specific uses of the ATV and the prevention of damage to materials.
   c. Field tensiometer calibration certificate showing that the equipment to be used for shear/peel testing in the field as been calibrated by a qualified individual within the previous 6 months.

4. During Installation Submitted Daily:
   a. Completed Subgrade Acceptance Form, as endorsed by the ENGINEER, prior to geomembrane deployment in any area.
   b. Construction progress reports clearly showing geomembrane placed by date.
   c. Passing and failing test results for trial seams.
   d. Documentation of passing and failing destructive and nondestructive testing of installed seams.

5. Within 5 days after completion:
   a. Summary and log of all field quality control work completed by the GEOSYNTHETICS CONTRACTOR.
   b. Certification statement signed by the Supervisor that geomembrane installation is complete and in accordance with these Specifications, with details of any changes or exceptions noted.
   c. Statement of material and installation warranties.

B. The above-noted requirements shall apply to all shop-fabricated materials and those items specified for fabrication in the field.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The GEOSYNTHETICS CONTRACTOR shall protect the work described in this Section before, during, and after installation, and shall protect the installed work specified in other Sections, as well as work completed by the OWNER.

B. Geomembrane labeling, shipment and storage shall follow ASTM D4551 as modified according to this Specification.

C. Product labels shall be placed on the top of panels such that they can be seen, clearly showing the fabricator or supplier name, product description, panel number, and panel dimensions.

D. Each panel of PVC shall include any additional information required to allow the ENGINEER to relate that panel with the manufacturing quality control and raw material quality assurance

documentation. Additionally, if any special handling is required, it shall be so marked on the outside surface of the wrapping.

E. During storage, the geomembrane shall be placed on a stable, relatively flat, dry, well-drained surface. The geomembrane pallets shall not be placed on objects that may cause deformation of the geomembrane panels. Adequate space shall be left between stored panels, such that panel labels can be examined. The geomembrane shall be protected from the following:
   1. Site construction damage.
   2. Chemicals that are strong acids or bases.
   3. Flames, sparks, geomembrane temperatures in excess of 150° F.
   4. Any environmental condition that might damage the geomembrane.

F. Panel numbers on partially used panels must be maintained such that each panel number can be readily identified prior to deployment of the remaining portions of the panel.

G. If the ENGINEER determines the geomembrane is damaged, the GEOSYNTHETICS CONTRACTOR shall make all repairs and replacements in a timely manner, so as to prevent delays in the progress of the work.

PART 2 - MATERIALS

2.1 GENERAL

A. The geomembrane sheet shall consist of polyvinyl chloride (PVC) resin in amounts greater than 50% of the total polymer content suitably compounded with plasticizers, stabilizers, additives, and pigments, to satisfy the physical property requirements and **shall measure at least 20 mil.**

B. The ENGINEER shall conduct conformance testing on the geomembrane. The GEOSYNTHETICS CONTRACTOR shall, at no additional cost to the OWNER, provide whatever reasonable assistance the ENGINEER may require in obtaining samples for conformance testing. Geosynthetic material sampling frequency shall be in accordance with ASTM D4354, unless determined otherwise by the ENGINEER. A qualified laboratory with GAI-LAP accreditation shall conduct conformance testing.

C. Conformance testing will be at the expense of the OWNER, unless the tests show the material does not comply with the Specifications, in which case the GEOSYNTHETICS CONTRACTOR shall pay the cost of re-sampling and testing.

D. The GEOSYNTHETICS CONTRACTOR shall be solely responsible for the quality of the material provided. Should any of the tests performed on the material yield unsatisfactory results, the GEOSYNTHETICS CONTRACTOR will be responsible for replacing the material with satisfactory materials without delay to the project or cost to the OWNER.

2.2 GEOMEMBRANE

ASTM D7176 Standard Specification for Non-Reinforced Polyvinyl Chloride (PVC) Geomembranes used in Buried Applications.

A. Manufacturer

1. E Squared PVC 20 mil ASTM-7176, Item # 7100-20120 – New Jersey, 401-585-7079 or another preapproved equivalent.

Certified Properties	ASTM	PVC 10	PVC 20	PVC 30	PVC 40	PVC 50	PVC 60
Thickness	D 5199	10 ±0.5 mil 0.25±.013mm	20 ±1 mil 0.51 ± .03 mm	30 ±1.5 mil 0.76 ± .04 mm	40 ±2 mil 1.02 ± .05 mm	50 ±2.5 mil 1.27 ± .06 mm	60 ± 3 mil 1.52 ± .08 mm
Tensile Properties[2]	D 882 Min						
Strength at Break		24 lbs/in 4.2 kN/m	48 lbs/in 8.4 kN/m	73 lbs/in 12.8 kN/m	97 lbs/in 17.0 kN/m	116 lbs/in 20.3 kN/m	137 lbs/in 24.0 kN/m
Elongation		250%	360%	380%	430%	430%	450%
Modulus at 100%		10 lbs/in 1.8 kN/m	21 lbs/in 3.7 kN/m	32 lbs/in 5.6 kN/m	40 lbs/in 7.0 kN/m	50 lbs/in 8.8 kN/m	60 lbs/in 10.5 kN/m
Tear Strength	D 1004 Min	2.5 lbs 11 N	6 lbs 27 N	8 lbs 35 N	10 lbs 44 N	13 lbs 58 N	15 lbs 67 N
Dimensional Stability	D 1204 Max Chg	4%	4%	3%	3%	3%	3%
Low Temperature Impact	D 1790 Pass	-10° F -23° C	-15° F -26° C	-20° F -29° C	-20° F -29° C	-20° F -29° C	-20° F -29° C

Index Properties	ASTM	PVC 10	PVC 20	PVC 30	PVC 40	PVC 50	PVC 60
Specific Gravity	D 792 Typical	1.2 g/cc	1.2 g/cc	1.2 g/cc	1.2 g/cc	1.2 g/cc	1.2 g/cc
Water Extraction Percent Loss (max)	D 1239 Max Loss	0.15%	0.15%	0.15%	0.20%	0.20%	0.20%
Volatile Loss	D 1203 Max Loss	1.5%	0.9%	0.7%	0.5%	0.5%	0.5%
Soil Burial	G 160 Max Chg						
Break Strength		5%	5%	5%	5%	5%	5%
Elongation		20%	20%	20%	20%	20%	20%
Modulus at 100%		20%	20%	20%	20%	20%	20%
Hydrostatic Resistance	D 751 Min	42 psi 290 kPa	68 psi 470 kPa	100 psi 690 kPa	120 psi 830 kPa	150 psi 1030 kPa	180 psi 1240 kPa

Seam Strengths	ASTM	PVC 10	PVC 20	PVC 30	PVC 40	PVC 50	PVC 60
Shear Strength[2]	D-882 Min	20 lbs/in 3.47 kN/m	38.4 lbs/in 6.7 kN/m	58.4 lbs/in 10 kN/m	77.6 lbs/in 14 kN/m	96 lbs/in 17 kN/m	116 lbs/in 20kN/m
Peel Strength[2]	D-882 Min	10 lbs/in 1.8 kN/m	12.5 lbs/in 2.2 kN/m	15 lbs/in 2.6 kN/m	15 lbs/in 2.6 kN/m	15 lbs/in 2.6 kN/m	15 lbs/in 2.6 kN/m

***FTB = Film Tearing Bond *MD = Machine Direction *TD = Transverse Direction**

Notes:
1. Certified properties are tested by lot as specified in ASTM D-7176.
2. Metric values are converted from US values and are rounded to the available significant digits.
3. Modifications or further details of test are described in ASTM D-7176.
4. Index properties are tested once per formulation as specified in ASTM D-7176.

A. Geomembrane Conformance Testing - The ENGINEER shall take samples of the geomembrane panel for conformance testing. Unless otherwise specified, samples shall be three feet long by the roll width and shall not include the outer wrap. The ENGINEER or authorized representative shall mark the machine direction on the samples with an arrow.
   1. Unless otherwise specified, conformance samples shall be taken at a rate of one per 100,000 square feet. An appropriate number of samples, as determined by the ENGINEER in accordance with ASTM D4354 will be taken. The ENGINEER will ship these samples directly to the CQA laboratory.
   2. Geomembrane conformance samples selected by the ENGINEER may be tested for any properties specified in Article 2.3, but shall as a minimum be tested for the following:

GEOMEMBRANE CONFORMANCE

MINIMUM TESTING AND FREQUENCY

PROPERTY	TEST METHOD	
Thickness	ASTM D 5199	
Strength at Break	ASTM D 882	
Elongation	ASTM D 882	
Modulus at 100%	ASTM D 882	
Tear Strength	ASTM D 1004	
Low Temperature	ASTM D 1790	

   3. Non-conforming material will not be used in the work. In the event nonconforming results are obtained from the laboratory, the nearest numbered rolls on each side of the non-conforming roll shall be sampled and tested for the full suite of conformance tests, until the extent of nonconformance is established, at no cost to the OWNER. The owner reserves the right to reject the lot of rolls at any stage of extended sampling and testing.

B. Interface Shear Testing - Interface shear strength testing of the geomembrane and related materials is the responsibility of the OWNER. The results must comply with the criteria determined by the OWNER, as specified in the Construction Drawings. All testing must meet the minimum requirements, and the analysis of those results must be completed by the ENGINEER prior to installation of the materials. Testing for geosynthetic to geosynthetic, or geosynthetic to soil interface, shall be conducted according to the current version of ASTM D 5321-92 (97). Testing for interfaces involving geosynthetic clay liner (GCL) shall be conducted according to the current version of ASTM D 6243-98.

2.3 FACTORY FABRICATION

A. All completed factory seams are 100% inspected. Factory seams will be visually inspected for full seam continuity over their full length. Any areas that do not meet the specified requirements shall be removed and repaired per section.

B. **The geomembrane within 15 feet of any trench must be constructed from a minimum of 15'-wide manufactured panel width. No longitudinal seams are allowed in the trench.**

C. Destructive tests will be performed to verify that the seam strength requirements of the specifications are met. Random samples shall be taken at a minimum of every 3,000 lineal feet of factory seam or once per factory panel fabricated, whichever is more frequent, and the following quality assurance tests will be performed on each sample:
   1. Thickness
   2. bonded seam strength (shear strength)
   3. peel adhesion

D. The sample shall be cut into ten one - inch wide specimens. Five peel and five bonded seam specimens are removed. Five specimens shall be tested for bonded seam strength (bss) and five for peel adhesion. To be acceptable, the average of five test specimens for peel and the average of five test specimens for bonded seam strength must meet the minimum peak load requirements of factory seams as follows:
   1. Bonded Seam Strength: One-inch strips cut with the weld centrally located are tested by stressing the weld in a "shear" configuration. That is, the top sheet is stressed in relation to the bottom sheet in a direction away from the weld. A pass result occurs when the specimen averages meet the minimum peak load requirements stated in the contract (usually 80% of specified sheet strength). A failure occurs when the weld separates or the material breaks at a peak load less than the minimum requirements. The test result to be reported will be the average of the peak loads recorded for each of the five specimens.
   2. Peel Adhesion: One-inch strips cut with the weld centrally located are tested by stressing the top sheet in relation to the overlapped edge of the lower sheet in an effort to peel the weld away. Each specimen will be peeled one inch along the seam length. A pass result occurs when the specimen meets the minimum peak load requirements stated in the contract. A failure occurs when the weld peels at a peak load less than the specification without film tearing bond. The test result to be reported is the average of the peak loads recorded for each of the four specimens.

E. Each test will be identified by panel serial number and the manufacturer's roll number. These tests shall be performed in the fabricator's laboratory.

F. Prior to installation of the geomembrane at the site, the fabricator will provide to the ENGINEER, copies of manufacturer material certifications and a copy of quality control test results for all panels to be supplied, verifying conformance with this specification and the requirements as represented in ASTM D 7176 specification. The location of any defects and repairs and all necessary retesting results will also be documented in the report.

G. When a seam sample is removed from the panel being fabricated the resulting hole will be repaired with a patch with a minimum of a one-inch bonded area around the patch, and the patch will be rounded on all corners.

H. Factory fabricated geomembrane panels are packaged accordion folded on a sturdy wooden pallet designed for forklift truck access. Smaller panels (i.e. less than 500 lbs.) can be rolled on a fiber core and placed on a pallet.

I. All panels will be packaged with a protective, black stretch wrap or cardboard cover to protect the panel from weather or shipping damage.

2.4 GEOMEMBRANE PENETRATION BOOTS

A. The GEOSYNTHETICS CONTRACTOR shall furnish all geomembrane penetration boots and other materials required for completion of the geomembrane installation. All geomembrane boots required for the project shall be factory prefabricated boots. The geomembrane shall be of the same thickness as the geomembrane panels.

B. Geomembrane penetrations are to be constructed only at the locations shown on the Plans. The GEOSYNTHETICS CONTRACTOR is cautioned that no deviation in the quantity or configuration of geomembrane penetrations will be accepted without the advance written approval of the ENGINEER.

C. All penetrations through the geomembrane shall be thoroughly and securely sealed. The seal between the geomembrane and the pipe shall be without any detectable leakage.

D. In attaching the geomembrane penetration boot in the field, no field seams will be allowed in locations or configurations that do not allow for Construction Quality Control testing. Visual observation is not considered a sole acceptable method for in-field quality control.

E. Where clamps, fasteners, gasket seals or sealants are used, the GEOSYNTHETICS CONTRACTOR shall use only materials that are compatible with the geomembrane.

PART 3 - EXECUTION

3.1 SITE PREPARATION

A. All required grading, grooming, and construction quality assurance (CQA) testing on any low permeability soil or GCL to be covered by the geomembrane shall be complete and accepted by the ENGINEER prior to geomembrane placement.

B. The surface to be covered by the geomembrane shall be cleared of sharp objects, angular stones, sticks, or any materials that may contribute to punctures, shearing, rupturing or tearing of the geosynthetic materials. The geomembrane subgrade shall have a smooth, finished surface, free from pockets, holes, ruts, and discontinuities that, in the judgment of the ENGINEER, will cause bridging of the material. The subgrade shall be inspected for unsuitable areas or soft spots before the geomembrane is placed, and additional surface preparation will be required to eliminate any unsuitable areas as determined by the ENGINEER.

C. The GEOSYNTHETICS CONTRACTOR and ENGINEER shall carefully and completely inspect the **subgrade surface immediately prior to the deployment of each geomembrane panel.** No geomembrane shall be placed on unsuitable subgrade surface, or without the ENGINEER's written approval. The ENGINEER and the GEOSYNTHETIC CONTRACTOR's Quality Control (QC) inspector shall furnish their signatures on a Subgrade Acceptance Log prior to the installation of each panel or series of panels placed on a daily basis.

D. Under no condition shall the geomembrane be placed over standing water on the subgrade.

3.2 SEAMING METHODS

A. A six - inch wide overlap must be cleaned of all dust, dirt or foreign debris no more than 30 minutes prior to welding. Only clean, soft rags will be used for cleaning. If mud has adhered to the sheet surface overlap area, it will be removed with clean water and allowed to dry prior to seaming.

B. During the cleaning operation, the sheet will be inspected for defective areas which must be removed and/or repaired prior to seaming. The seaming operation requires a solid, smooth subsurface. Subsurface voids, hard nodules, rocks, soft areas or unsuitable conditions will be removed or repaired prior to seaming during subgrade preparation.

C. Seaming cannot be conducted in the presence of standing water. Wet surfaces must be allowed to dry. A slip sheet or seaming board may be used to lift the geomembrane above damp surfaces. If wind conditions contaminate the seaming area or displace the geomembrane sheets, temporary ballast and additional cleaning procedures will be required.

D. The geomembrane panels shall be joined utilizing approved seaming methods. Dual-track fusion welding shall be the required method on all seams where it is feasible. Chemical welds shall be made only where approved by the ENGINEER.

E. All geomembrane surfaces that are to become a seam interface are to be free of dust, dirt, excess moisture or any other condition that may affect the quality of the seam.

F. Seaming will not be allowed during rain or snowfall, unless proper precautions are made to allow the seam to be made on dry subgrade and geomembrane materials. If weather conditions are not satisfactory, panels will not be put into place. If panels are placed and pulled out, the installation crew will do what is necessary to finish or secure those individual panels that day.

G. The field seams shall be produced using one of the following methods:
   1. Dual-Track Thermal Fusion Weld – All field seams shall be fused using Dual-Track Thermal Fusion Welding. A seam produced by melting the two intimate surfaces by running a hot metal wedge or hot air device between the surfaces, followed immediately by pressure to form a homogeneous bond. This seam has a center air channel for non-destructive testing of the seam. Panels to be seamed shall be overlapped sufficiently to allow proper destructive testing of seams. The CONTRACTOR shall mark the liner where the Dual-Track Fusion Welding machine settings are adjusted (including speed, temperature and pressure). Measurable setting values shall be indicated on the liner.
   2. Chemical Fusion Weld – Chemical Fusion Welding shall only be used for repairs and detail work. All field seams will be a minimum of 2 inches wide. A sufficient amount of chemical fusion agent will be applied that, upon compressing the seam surfaces together, a thin excess of chemical fusion agent will be forced out. A high durometer rubber, nylon or steel roller will be used to compress the seam surfaces together until a bond is formed. Roller action will be at a parallel direction to the seam's edge so that excessive amounts of chemical fusion agent will be purged from between the sheets. Trapped chemicals should be rolled out of the seaming area. Care will be exerted in applying the chemical fusion agent. A continuous wet layer of chemical fusion agent is necessary to prevent a leak at the tie - in point between the last chemical fusion agent application and the next. If the chemical fusion agent, which is initially shiny when applied, takes on a dull filmy appearance, the interfaces may require a faster closing together or the ambient temperature is too high to continue seaming. The installer will monitor this condition at sheet temperatures over 105°F. At the completion of seaming, all rags, chemical containers, etc., will be properly removed from the geomembrane.

3.3 INSTALLATION

A. The number of panels to be deployed in any day will be limited to the number of panels which can be seamed that day. The geomembrane will be placed over the prepared surface in such a manner as to assure minimum handling.

B. Based on the approved geomembrane panel diagram and material certifications, the individual panels will be numbered, and seams will be identified by using the panel numbers that create the seam. The PVC panels shall be installed in a manner that minimizes seams. Wherever possible longitudinal seams shall be oriented to be no greater than ten degrees from parallel with the direction of the slope. Cross seams (i.e. those seams which join the ends of contiguous panels) shall not be placed on any slope that exceeds a ten percent grade. All panels placed on slopes shall be cut no closer than five feet from the top of the slope or ten feet from the toe of slope. All seam overlaps shall be shingled in a downslope direction. In no case shall parallel seams be placed within five feet of the centerline of any leachate collection pipe.

B. During installation, and any other period of exposure of geomembrane, pedestrian and equipment activity over the geomembrane shall be kept to a minimum and restricted to only that which is necessary for geomembrane construction.

C. Smoking is not permitted on the geomembrane.

D. Construction workers shall take precautions not to damage the geomembrane surface. Construction workers shall wear smooth-soled footwear, and exercise care not to drag tools across the geomembrane surface. All large tools are to have smooth base plates or shoes. Construction and landfill staff shall be informed of the restricted access to areas of geomembrane placement by use of barriers and signs posted as necessary.

E. The GEOSYNTHETICS CONTRACTOR shall perform all activities of geomembrane construction in such a way as to avoid damage to the geomembrane. Any damage caused to the geomembrane by the GEOSYNTHETICS CONTRACTOR shall be repaired or the material replaced at the expense of the GEOSYNTHETICS CONTRACTOR.

F. No tracked or wheeled vehicles, other than low ground pressure ATVs as preapproved by the ENGINEER, shall be permitted on the geomembrane prior to placement of adequate soil cover, as determined by the ENGINEER.

G. The GEOSYNTHETICS CONTRACTOR shall complete his work in a manner that will prevent water or wind from getting under the partially installed geomembrane. This could include, but is not limited to, installing sandbags along the leading edges. Should excessive moisture become trapped below the geomembrane, or should wind damage occur due to the negligence of the GEOSYNTHETICS CONTRACTOR, the GEOSYNTHETICS CONTRACTOR, at no extra cost to the OWNER, will be required to perform all work, including removing and replacing as much of the in-place geosynthetic material as the ENGINEER directs, to assure that the integrity of the geomembrane and the underlying subbase or geosynthetic clay liner (GCL) has not been compromised.

H. Seams shall be welded throughout the entire length of the panels during initial panel seaming.

I. Sandbags or other approved ballast shall be used to prevent bridging or material movement in areas such as toe of slope or near sumps. Ballast shall not be used to force the geomembrane into contact with the subgrade.

J. Special care shall be taken to prevent tensile stress in the geomembrane and geomembrane seams in all corners and grade changes.

K. The GEOSYNTHETICS CONTRACTOR shall exercise his best judgment and care to provide sufficient slack in the PVC geomembrane.

L. The geomembrane shall not be installed when ambient or sheet temperatures are below 32° F, when the sheet temperature exceeds 158° F, or when the air temperature is above 120° F unless the GEOSYNTHETICS CONTRACTOR demonstrates, to the satisfaction of the ENGINEER, that procedures can be implemented which will result in the proper installation and seaming of the geomembrane.

M. Adjacent geomembrane panels shall be allowed to reach essentially equivalent temperatures prior to seaming to avoid development of fish mouths.

N. If fish mouths are created at the seam overlaps, they shall be cut to achieve a flat overlap.

O. Geomembrane covering operations shall be performed in a manner that does not damage the geomembrane lining system. Geomembrane covering operations shall be performed only in the presence of a Construction Observer such that the condition and cleanliness of the geomembrane is observed at the time the material is covered, and any effects of the covering operation on the geomembrane lining system can be observed.

P. Any use of ATV's on the site must be pre-approved by the ENGINEER. The GEOSYNTHETICS CONTRACTOR shall submit an S.O.P. describing how ATV's are to be used, if at all, in the deployment of geomembrane at the site. As a minimum, the following shall apply:
   1. Any damage resulting from the use of ATV's, as determined by the ENGINEER, shall be repaired according to Article 3.3, at no additional cost to the OWNER. If repeated repairs are required as the result of the use of ATVs operating on geosynthetic material, further use of ATVs will be prohibited.
   2. Any and all ATV's proposed to be used in the deployment of geosynthetics will be inspected by the ENGINEER. ATV's which are found to be leaking oil or fuel, or which in any other way exhibit the potential to damage the lining system components, will not be permitted.
   3. Any oil or fuel which leaks onto geosynthetic materials shall be thoroughly removed (cleaned) by the GEOSYNTHETICS CONTRACTOR, or the geosynthetic material shall be replaced at the discretion of the ENGINEER, at no additional cost to the OWNER.
   4. Re-fueling of ATVs on geosynthetic materials is prohibited.
   5. ATVs shall have tires with low ground pressure, typically less than 5 psi, and shall have shallow treads.
   6. ATVs shall be operated by a single operator at speeds less than 5 mph.
   7. Quick starts, stops, spinning wheels and sharp turns will not be permitted above any geosynthetic material.

3.4 REPAIRS

A. All geomembrane panels and seams shall be examined by the ENGINEER for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The geomembrane surface shall be clean at the time of examination. Each suspect location shall be repaired, and all repairs shall be non-destructively tested.

B. Damaged geomembrane shall be removed and replaced with acceptable geomembrane if damage cannot be repaired to the satisfaction of the ENGINEER.

C. Any portion of the geomembrane, or any portion of a seam exhibiting a flaw or failing a destructive or non-destructive test, shall be repaired as follows:
   1. Geomembrane patches shall be used for holes over 1/8 of an inch in diameter, tears, and contamination by foreign matter. Patches shall be constructed of the same geomembrane and will be joined to the panel using adhesive or chemical fusion welding where possible.

2. Geomembrane patches or caps shall extend at least 6 inches beyond the edge of the defect or failed seam area, and all corners of material to be patched. The corners of the patch shall be rounded.
3. Geomembrane caps shall be used to repair failed seams that are left in place. Seams that fail destructive or non-destructive testing may also be removed and replaced if determined necessary by the ENGINEER.

PART 4 - FIELD QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

4.1. GENERAL

A. Before installation begins, and weekly thereafter (more often if determined necessary by the ENGINEER) project coordination meetings shall be held with the designated representative of the EARTHWORKS CONTRACTOR, GEOSYNTHETICS CONTRACTOR, ENGINEER and OWNER in attendance to review the following information:
   1. Progress of the work.
   2. Adherence to the Specifications.
   3. Adherence to the Construction Quality Assurance Program described in this Section, including the timely submission of the pertinent forms.
   4. Planned work and methods for the ensuing week, including estimate of time remaining to completion of the work.
   5. Problem resolutions to be implemented during the upcoming week.

B. All of the Forms specified and required must be submitted to the ENGINEER in a timely fashion.

C. The OWNER and ENGINEER must approve any changes in the proposed method of work, subcontractors to be utilized, geomembrane resin, or manufacturing in advance.

D. The GEOSYNTHETICS CONTRACTOR assumes all responsibility relevant to providing an acceptable product.

4.2. INSTALLATION QA/QC

A. The ENGINEER and GEOSYNTHETICS CONTRACTOR shall visually inspect all material to be included in the work and compare panel identification numbers with those on the certifications provided by the manufacturer to assure delivery of the appropriate material.

B. Damage to geomembrane during installation shall be repaired according to Article 3.4. If the ENGINEER determines that any damage cannot adequately be repaired, the damaged material will be replaced.

C. The GEOSYNTHETICS CONTRACTOR will be required to conduct both destructive and non-destructive testing on seams during the geomembrane installation, as part of the Construction Quality Control program. All trial and installed seam samples shall be tested.

D. Thermal Weld Trial Seams –
   1. Trial seams shall be produced each day, at the start of each workday, after every four hours of continuous operation, after each break in seaming of 1 hour or more, after a break that results in equipment replacement or shutdown, and if the geomembrane temperature changes by more than 45°F. Trial seams shall be required each day for each piece of seaming equipment and each welding crew combination (including welding technician, seam cleaners and/or helpers). The trial seams will be performed on strips of geomembrane from approved rolls and shall be produced at the work location such that the conditions mimic those under which production seams will be made.

2. A trial seam shall be a minimum of 5 feet in length for self-propelled seaming devices, and a minimum of 3 feet for hand-held seaming devices. The material for the trial seam and the test fixture for ma king the field tests shall be provided by the GEOSYNTHETICS CONTRACTOR at no additional cost. One-inch wide cutouts of the trial seams will be subject to shear and peel testing at the site. A minimum of 3 cutouts will be tested for shear, and a minimum of 3 cutouts will be tested for peel. The ENGINEER shall document the locus of break code for each specimen as shown in Figure 3 and Figure 4 of ASTM D6392-99, included at the end of this Section.
3. All trial seam specimens must be acceptable, or the trial seam will be repeated until all results from a given trial seam are found acceptable. If any trial seam fails at any time during the workday, the reason for the failure shall be resolved before any production seaming of the geomembrane by the subject equipment and crew. All trial seam welding and testing must be observed by the ENGINEER.
4. A trial seam specimen will be considered a failure if:
    a. In the shear test, the bonded thickness of the seam fails or the material breaks at a stress lower than specified.
    b. In the peel test, the two sheets comprising the seam separate at a peak stress lower than specified. Should the ENGINEER, at any time during the installation, believe the production seaming process may not be performing adequately, he may, to avoid destructive sampling of the installed geomembrane, request additional trial seams. The GEOSYNTHETICS CONTRACTOR at no additional cost shall do this.

E. The GEOSYNTHETICS CONTRACTOR shall complete non-destructive testing of all seams along their entire length, in the manner approved prior to installation, in the presence of the ENGINEER. The recommended test methods are as follows:
1. Pressurized Air Channel
    a. All field seams made by a dual-track fusion welding device will be tested by applying air pressure within the air channel to a sealed length of seam, and monitoring the pressure over time. The testing shall be conducted in accordance with ASTM D 7177.
    b. **For the geomembrane, the initial inflation pressure shall be equal to or greater than the minimum according to ASTM D 7177. The minimum allowable pressure drop over a 30 second period shall be 150.0 psi.**
    c. A pressure gauge shall be inserted into the end of the air channel to check for continuity in the air channel. Alternately, the far end of the seam may be cut to relieve the air pressure. An audible rush of air shall serve as an indicator that the test represents the entire length of seam.
    d. Air channels that do not hold the minimum specified air pressure shall be further inspected to identify the location and nature of any defects or unbonded sections of seam. The seam will then be repaired and retested. The ENGINEER may, at his discretion, require the entire questionable seam area to be capped or replaced.

2. Air Lance Testing
    a. The ENGINEER shall witness the testing, and the seam shall be clearly visible to the ENGINEER and GEOSYNTHETICS CONTRACTOR during the test. Unbonded areas or defects shall be marked by the ENGINEER for repair by the GEOSYNTHETICS CONTRACTOR.
    b. The air lance will be capable of supplying 50 PSI through a 3/16-inch diameter nozzle. The air stream is directed at the upper edge of the seam no more that 2 inches from the seam edge. Any voids in the seam will be marked, repaired, and re-tested with the air lance. The testing technician and the inspector will mark each seam or repair with an indelible marker as accepted immediately after completion of final air lance testing.

F. All inadequate seams or portions thereof that fail the non-destructive testing shall be repaired in accordance with this Specification and the method approved by the ENGINEER. Should differences of opinion between the GEOSYNTHETICS CONTRACTOR and the ENGINEER develop during the installation relevant to seam integrity, the ENGINEER may, at his discretion, obtain samples of the seams in dispute for field and/or laboratory testing. The GEOSYNTHETICS CONTRACTOR will be responsible for patching the resulting void in accordance with the previously approved procedures at no additional cost to the OWNER.

G. Destructive Sample Collection - Samples of the in-place seams shall be cut from the installed geomembrane at a minimum frequency of one sample per 500 linear feet of seam, excluding repair seam length. A minimum of one seam sample shall be obtained for each seaming machine/operator combination for each day, or as directed by the ENGINEER. The cutout sections shall be 12 inches wide by 40 inches long with the seam centered lengthwise. The sample size can be reduced to 30" if the CONTRACTOR does not elect to have a cutout section for their use. A 1-inch wide specimen shall be cut from each end of the sample, and these two specimens shall be peel tested in the field in accordance with 4.2 G. The remaining sample shall be cut into 2 parts and distributed as follows:
   1. One 12-inch by 18-inch sample to the ENGINEER for independent laboratory testing; and,
   2. One 12-inch by 18-inch sample to the OWNER for archive storage.
   3. The remainder of the sample shall be available for the CONTRACTOR if requested at the time of sample collection.

H. The 12-inch by 18-inch laboratory sample will provide 5 specimens for shear testing and 5 specimens for peel testing. Specimens that will be subject to peel and shear testing shall be selected alternately from the sample. All peel tests shall be performed on the outer track of dual track fusion welds. The laboratory shall report the locus of break code for each specimen according to the definitions included in Figure 3 and Figure 4 of ASTM D 6392, included at the end of this Section. The laboratory sample will be considered acceptable only if all 10 specimens meet the minimum requirements. The specimen will be considered a failure if:
   1. In the shear test, the bond of the seam fails or the material breaks at a stress lower than specified.
   2. In the peel test, the two sheets comprising the seam separate at a peak stress lower than specified. Complete peel separation of the seam is allowable.
   3. In the shear or peel test, locus of break codes AD, AD-BRK, BRK, and SE are reported by the ENGINEER.

I. If a sample fails destructive testing, the welding path must be retraced to intermediate locations at least 10 feet in each direction from the location of the sample that failed the test, and a second sample shall be taken for an additional field test. If the tracking samples pass, the seam must be reconstructed between the location of the two tracking samples and the original sampled location. If the tracking sample fails, this process must be repeated. The seam between 2 passing test locations shall be capped, the cap seams shall be nondestructively tested, and shall include one field peel and shear test location along the reconstructed seam.

J. The ENGINEER and GEOSYNTHETICS CONTRACTOR shall visually inspect all geomembrane seams.

K. All welds shall be observed for traces of deformation to the geomembrane panels. Any seams, which in the opinion of the ENGINEER, have caused excessive deformation of the sheet, show signs of discoloration, exhibit thinning or stepping of the sheet, or show visual signs of overheating of the geomembrane panels, shall be repaired at no additional cost to the OWNER regardless of the result of any destructive testing on the seam. The deficient seam or portion thereof shall be cut out, the geomembrane panels again overlapped and seamed, or the questionable seam length shall be capped, as approved by the ENGINEER.

L. The GEOSYNTHETICS CONTRACTOR shall not place overlying materials on the installed geomembrane until the ENGINEER has reviewed and accepted the written test results for the geomembrane to be covered. At a minimum, the predelivery testing, the daily log of trial seam results, laboratory destructive sample results, non-destructive test results, record drawings of the completed area, and approval of the seams in place will be reviewed.

M. The GEOSYNTHETICS CONTRACTOR shall provide a report to the OWNER and the ENGINEER at the conclusion of the work which shall include the following:
1. The quality control tests used as specified and/or directed, including all requirements of the Report section of the specified test method.
2. Complete description of field sampling procedure, number of test specimens, size of test specimens.
3. Log of all Construction Quality Control work.

N. The GEOSYNTHETICS CONTRACTOR shall be responsible for all costs incurred by the OWNER including, but not limited to, additional field and laboratory CQA testing resulting from greater than 5 percent of the CQA testing not meeting or exceeding the Specifications.

O. All seams that cannot be subjected to the required Construction Quality Control or Construction Quality Assurance (CQA/CQC) testing shall be overlapped.

4.3. WARRANTY

A. The GEOSYNTHETICS CONTRACTOR shall issue a warranty on the installation of geomembrane for a minimum period of 1 year.

B. The GEOSYNTHETICS CONTRACTOR shall issue a warranty on the geomembrane material for a minimum period of 20 years.

END OF SECTION 32 05 19.18

SECTION 32 11 23.23 - "FREE-DRAINING STONE" BASE FOR SYNTHETIC TURF SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers the installation of a "free draining stone" base to provide a vertical drainage system beneath an infilled synthetic turf.

1.2 RELATED WORK

A. 31 20 00 – Earthwork

B. 31 23 00 - Construction of Underground Utilities

C. 32 05 19.17 HDPE- Geomembrane HDPE Liner

D. 32 05 19.18 PVC- Geomembrane PVC Liner

E. 33 41 00 - Storm Sewer and Appurtenances

1.3 QUALITY CONTROL

A. Contractor shall use an independent testing laboratory selected by the Owner to provide testing of the "free draining stone" base material.

1.4 SUBMITTALS

A. Submit the "free draining stone" base material to the Testing Laboratory for testing. The quantity of the "free draining stone" base material for testing to be determined by the Testing Laboratory.

1.5 STORAGE AND HANDLING

A. The "free draining stone" base material used for placement around the subdrain system may be temporarily stored on a clean, hard surface to prevent contamination of the stone material. Stone material used for placement on the subgrade shall be delivered and back dumped onto the subgrade such that the delivery truck is not traveling on the subgrade itself. The stone material shall be pushed onto the subgrade by working off of previously placed material. Contractor shall sequence delivery of the stone material to minimize storage of the material on site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. "Free Draining Stone" Base
   1. The "free draining stone" base material shall consist of clean washed gravel or crushed stone. Soft limestone or other soft materials are not acceptable. The "free draining stone" base material shall not lose more than 12% by weight when tested for weathering stability based on ASTM C-88 sodium sulfate soundness test. The "free draining stone" base

material shall be tested by the L.A. Abrasion test, ASTM C-131, with a percentage lost by weight not exceeding 40.

2. The "free draining stone" material shall have the following gradation as a guide for selection of material:

Sieve Size	Percent Passing	
	Base Stone	Finishing Stone
1 1/2"	100	
1"	95-100	
1/2"	25-60	100
3/8"		40-75
#4	0-10	5-25
#8	0-5	0-10

3. The "free draining stone" material shall be checked for the following:
   a. Structural stability: $D60/D10 > 5$ and $\frac{1 < D\ 2/30}{D10\ D60} > 3$
   b. Fragmentation shall be 100%.
   c. Separation of both stones: $\frac{D85 \text{ of finishing stone}}{D15 \text{ of base stone}} > 2$

      And

      $3 < \frac{D50 \text{ of base stone}}{D50 \text{ of finishing stone}} < 6$
   d. Drainage: Permeability of base stone > 600 in/hr. (0.42 cm/sec.)
      Permeability of finishing stone > 150 in/hr. (0.106 cm/sec.)
      Porosity of both stones > 25%
      (when the stone is saturated and compacted to 95% max. density)
   e. Depending on the type of stone used, other mechanical characteristics may be necessary for approval.

PART 3 - EXECUTION

3.1 SUBDRAINS

A. The Contractor shall layout and excavate all of the trenches for the storm sewer system on the perimeter of the athletic field. The trenches shall be excavated to proper width and grade to allow for the placement of the geomembrane liner and "free draining stone" material in the trench. Trench walls shall be cut straight without sloughing of any material from the sidewalls. Bottom of the trenches shall be graded smooth and compacted to 95% maximum density ASTM D698. All excavated material for the storm sewer system shall be removed and the subgrade shall be cleaned, graded and amended as required to maintain the design elevations of the subgrade.

3.2 GEOMEMBRANE LINER

A. The geomembrane liner shall be installed the length of the playing field. A separate liner panel shall be used for each trench. End seams will not be allowed in the trench. Place liner in trench so that fabric at a higher elevation overlaps liner at a lower elevation to prevent free water from

running underneath the liner in the event of a tear or hole. The geomembrane liner shall be installed in accordance with SECTION 32 05 19.17.

3.3 GRAVEL DRAINAGE - TRENCHES

A. With the geomembrane liner in place, the Contractor shall place initial “free draining stone” in the perimeter storm sewer trench and then place the perforated storm sewer pipe to design grade and alignment, as specified and/or shown on the drawings.

B. After storm sewer pipe is in place and has been approved by Owner’s Representative, Contractor shall place “free draining stone” around the sides of the pipe and continue to fill the trench with the “free draining stone” to the elevation of the subgrade.

C. The Contractor shall install composite drains on top of the geomembrane liner in the pattern as shown on the drawings.

3.4 “FREE DRAINING STONE” BASE AND FINISH COURSE

A. The Contractor shall inspect the surface of the geomembrane liner to assure there are no irregularities in elevation, wrinkles in the liner and that the surface is free of any debris.

B. The “free draining stone” shall be laid without damaging the subgrade, geomembrane liner or composite drains by back dumping the stone material onto the geomembrane liner so as to keep the delivery trucks off the liner. Contractor shall use the proper equipment to push the stone material over the athletic field.

C. The “free draining stone” base and finish courses shall have a combined minimum thickness of 6-inches at the centerline of the athletic field. The “free draining stone” base course shall be placed in maximum 6” lifts. The top 1 to 2-inches of the “free draining stone” base shall be a finishing stone of the gradation listed above. The “free draining stone” material shall maintain a moisture content of 90% to 110% of optimum moisture at all times. Contractor shall ensure the stone at the plant meets this requirement and shall maintain this moisture content while placing, grading and compacting the stone material. The “free draining stone” base and finish courses shall be compacted to 95% maximum density ASTM D698, and shall have a maximum deviation from design grade of +0” to -1/4” in 10’ feet when measured in any direction using a 10’ straight-edge.

D. After the “free draining stone” has been finished to grade, at the Owners option a minimum of five (5) permeability tests shall be made at random locations on the “free draining stone” base in accordance with ASTM D3385 test methods.

E. If the “free draining stone” base fails to meet any of the design specifications, it shall be the Contractor’s responsibility to restore at his expense, the materials to meet all requirements for permeability, cross-section, grade and density as outlined in the specifications. The “free draining stone” base shall be approved by the Owner’s Representative before the Contractor is allowed to install the synthetic turf.

3.5 DISPOSAL OF WASTE MATERIAL

A. All excess excavated material, debris or other objectionable material shall become the property of the Contractor and shall be removed from the project site and legally disposed of at no cost to the Owner.

END OF SECTION 32 11 23.23

SECTION 32 13 13 - CONCRETE PAVING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete paving, including, but not limited to, parking lots, aprons, sidewalks, curbs, handicapped accessible ramps, approaches, and miscellaneous exterior concrete shown on drawings.

B. Traffic lane and parking space paint striping, including, but not limited to, painting of curbs and stenciling of signs stipulating FIRE LANES, NO PARKING and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction.

C. Precast concrete wheel stops and accessories are shown in the drawings.

1.2 QUALITY ASSURANCE

A. Where standards or requirements of this Section are in conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)
   1. M-90
   2. M-213

B. American Concrete Institute (ACI)
   1. 305, Hot Weather Concreting
   2. 306, Cold Weather Concreting

C. ASTM International (ASTM)
   1. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
   2. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   3. C33, Standard Specification for Concrete Aggregates
   4. C94, Standard Specification for Ready-Mixed Concrete
   5. C150, Standard Specification for Portland Cement
   6. C260, Standard Specification for Air-Entraining Admixtures for Concrete
   7. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
   8. C494, Standard Specification for Chemical Admixtures for Concrete
   9. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
   10. C920, Standard Specification for Elastomeric Joint Sealants
   11. C979, Standard Specification for Pigments for Integrally Colored Concrete

D. Federal Specifications (FS)
   1. TT-S-00227E, Elastomeric Joint Sealants

2. TT-P-1952B, Traffic and Airfield Marking Paint, Water Emulsion Base

1.5 PROJECT CONDITIONS

A. Do not place concrete in contact with frozen earth. Do not commence concrete placement unless the temperature is at least 35 degrees F and rising, or slabs until the temperature rises above 40 degrees F.

B. Discontinue concrete placement when air temperatures exceed 100 degrees F.

C. Dispose of any concrete that exceeds 95 degrees F as determined by the construction management personnel in the field.

D. Do not place concrete during rain.

E. Cold Weather Placing: Comply with ACI 306 to protect all concrete work from physical damage and reduce strength caused by frost, freezing actions, or low temperatures. Place no concrete against frozen earth.

F. Hot Weather Placing: Prepare aggregates, mix water and other ingredients, and place, cure, and protect concrete according to the requirements of ACI 305.

G. Do not apply traffic or zone marking paint on wet or damp surfaces or when rain is imminent. Do not commence painting operations until material, air, and/or surface temperature and dew point are within the paint manufacturer's recommended application limits.

1.6 TESTS AND INSPECTIONS

A. Before starting any work under this section, make all required arrangements with the testing agency. Provide testing laboratory with certified reports on proposed cement, aggregates mixing water, and admixtures.

B. Lab shall review design mixes for each type of concrete using previously tested and approved materials.

C. The testing lab will proportion mixes by laboratory trial batch, using materials to be employed in the work for each class of concrete required and reporting to the Architect.
1. Concrete Compression Test - 7-day and 28-day
2. Concrete Slump Test
3. Concrete Air Content

D. Furnish certified reports of the format shown herein of each proposed mix for each type of concrete at least 30 days prior to the start of installation of the Work of this Section.

E. Furnish ready mix delivery tickets to the field personnel upon request.

1.7 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature for concrete admixtures.

B. Shop Drawings: Show locations and installation procedures. Include details of joints, accessories, reinforcement, and clearances. Include a concrete placement sequence schedule.

C. Concrete Design Mix Reports:
1. One (1) for each type of concrete to be used.

D. Submit product data and shop drawings for ALL items to be installed.

E. Refer to Section 01 33 00 for submittal procedures.

1.8 INSTALLATION CONFERENCE

A. Refer to Section 01 31 13 – Project Coordination

B. Required Participants:
1. General Contractor Superintendent
2. Placement and Finishing Foreman
3. Concrete Supplier
4. Testing Lab

1.9 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2. 1 APPROVED MANUFACTURERS

A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years of experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 33 00, Submittals to be considered prior to proposal.

2. 2 MATERIALS

A. Formwork:
1. General: Contractor may use any of the following formwork materials if material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
   a. Wood Forms:
      1) Plywood: PS 1, Douglas Fir or Spruce species.
      2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
      3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.
   b. Prefabricated Forms:
      1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
      2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Metal Reinforcement:
1. Bars:
   a. Conform to ACI 315, latest edition.
   b. Comply with ASTM A615, Grade 60, deformed billet steel bars, unfinished, except Number 3 bars shall comply with ASTM A615, Grade 40, deformed billet steel bars, unfinished.

2. Tie Wire: 16 gauge annealed.

C. Concrete Materials (Other than concrete for extruded curbs, unless noted otherwise)
1. Cement: Type 1, ASTM C150, unless approved otherwise by Architect. Use one (1) brand of cement for entire project.
2. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturer and used in compliance with manufacturer's recommendations.
   a. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures. Provide one (1) of the following, or Architect approved equal:
      1) Eucon AEA-92 and Eucon Air Mix 200 by The Euclid Chemical Company.
      2) Sika AEA 14 by Sika Corp.
      3) MasterAir AE or MasterAir VR by BASF Admixtures.
   b. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
      1) Eucon WR 75 or Eucon WR 91 by The Euclid Chemical Company.
      2) Master Pozzolith 322 by BASF Admixtures.
      3) Plastocrete 161 by Sika Corp.
   c. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or Type G and containing not more than 0.05 percent chloride ions. Provide one (1) of the following, or Architect approved equal:
      1) Eucon 37 by The Euclid Chemical Company.
      2) ViscoCrete by Sika Corp.
      3) Master Rheobuild 1000 by BASF Admixtures.
3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
4. Integral Color Pigment (Required for new concrete handicapped accessibility ramps): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer’s standard color line. Provide one (1) of the following, or Architect approved equal:
   a. ChemSystems, Inc.
   b. Davis Colors
   c. New Riverside Ochre Co., Inc.
   d. Scofield Decorative Concrete by Sika Corp.
5. Color Stain (Required for existing concrete handicapped accessibility ramps): A penetrating acrylic concrete stain, designed for adding color to existing concrete. Color(s) shall be as selected by Architect from manufacturer’s standard color line. Provide H & C Silicone Acrylic Concrete Stain manufactured by Sherwin Williams, or Architect approved equal.
6. Aggregates:
   a. Comply with ASTM C33
   b. Maximum size not larger than 1/5 of narrowest dimension between forms of the member for which concrete is to be used. Not larger than 3/4 of minimum clear spacing between reinforcing bars.
   c. 1-1/2 inch maximum in paving slabs.
7. Strengths:
   a. Five and a half (5.5) sack (shall contain no less than 5.5 sacks of Portland cement)/3,500 psi/28 days.
   b. Strength recommendations on Drawings supersede when they are greater than specified here.
8. Water: Drinking quality.
9. Water - Cement Ratio (lb water per lb of Portland cement):
      1) 0.52 Maximum

10. Slump:
    a. Slump shall be 4 inches plus or minus 1 inch, unless specifically noted otherwise.

D. Joints:
1. Construction Joints and Expansion Joints: Refer to Paragraph on Accessories below.
2. Tooled Control Joint: Scored ¼-inch wide x 1/4 thickness of concrete in depth.

E. Accessories:
1. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height directly on properly prepared and compacted subgrade. No sand cushion pads will be permitted. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Dayton Superior, MEDCO PC-4 by Meadow Burke, a CHR Company, GTI Bar Chair by General Technologies, Inc., or approved equivalent. Maximum spacing of chairs shall be 36-inches on center each way.
2. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture.
3. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
4. Epoxy Adhesive: ASTM C881, two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following, or approved equal:
    a. Euco #452 Epoxy System or Euco #620 Epoxy System by The Euclid Chemical Company.
    b. Sikadur Hi-Mod by Sika Corp.
5. Expansion Joints:
    a. Fiber Joint Filler: Pre-molded asphalt impregnated rigid fiber board. Comply with AASHTO M-213. Use 3/4-inch-thick at expansion joints adjacent to extruded curbs, 1/2-inch-thick at perimeter of footings for ground-set items such as bollards and fence posts where such footings are incorporated into slabs; elsewhere as shown.
    b. Wood Expansion Joints: Where indicated in the drawing provide construction clear heart grade redwood joints conforming to AASHTO M-90. Provide sizes indicated on drawings. Do not install adjacent to curbs.
    c. Joint Sealant: Shall be a self-leveling silicone base, cold-applied joint sealing compound complying with DOWSIL 890-SL Silicone Joint Sealant as manufactured by Dow Silicones Corporation or approved equal.
6. Load Transfer Units:
    a. Light Duty (sidewalk): 3/4 inch thick clear heart redwood expansion joint form with minimum one (1) inch deep removable top strip, 1/2 inch x 10 inch smooth steel reinforcing bars at 12 inches on center +/- with bond breaker sleeve on one (1) side, and 3/32 inch thick steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
    b. Medium Duty (Auto) / Heavy Duty (truck/bus traffic): 3/4 inch thick redwood expansion joint form with minimum one (1) inch deep removable top strip, 3/4 inch by 18 inch steel reinforcing bars at 12 inches on center+/- with bond-breaker sleeve on one (1) side and 3/16 inch steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.

F. Curing Compound: The compound shall conform to ASTM C309-1315, Type II (A.I.M. Regulations - VOC Compliant). Provide 1600 White by W. R. Meadows, Inc., or equal products by BASF Admixtures, Dayton Superior, or approved equal.

G. Other Materials: Provide all items required to complete work which is not specified, or which is not to be provided by other trades.

H. Extruded Concrete Curbs:
   1. Materials:
      a. Portland Cement: ASTM C150, Type I.
      b. Aggregate: ASTM C33.
      c. Water: Clean, free of contaminating material.
   2. Epoxy Adhesive: As specified under concrete materials above.
   3. Concrete Mixing:
      a. Slump: No slump allowed.
   4. Curing Compound: As specified under concrete materials above.

I. Traffic and Zone Marking Paint: (As shown on drawings or required)
   1. Type: chlorinated rubber paint conforming to the requirements of TT-P-115E. Sherwin Williams product Setfast Chlorinated Rubber Zone Marking Paint TM5126 – White and TM5127 – Yellow or approved equal.
   2. Stripe Size: Four (4) inches wide for traffic and parking lanes, unless noted otherwise.
   3. Colors:
      a. Traffic and Parking Striping / crosswalks, directional arrows: White or as selected by Architect.
      b. Fire Lanes: All curbs at driveways adjacent to building shall be painted solid red with white stenciled lettering to read “FIRE LANE, NO PARKING” in size and spacing required by authorities having jurisdiction. Contractor to verify requirements of local jurisdiction for fire lane striping.
      c. Accessibility Handicapped Parking: Symbols and spaces shall be in size and color in accordance with ADA and TAS authorities having jurisdiction.

J. Precast Concrete Wheel Stops: (As shown on drawings or required)
   1. **Precast of 3,000 psi air-entrained concrete, approximately 9.5 inches high x 12 inches wide x 8 feet-0 inches long, with chamfered top corners and drainage slots underneath for buses (please refer to plans). Unit shall weigh minimum 800 lbs.**
   2. **Precast of 3,000 psi air-entrained concrete, approximately 6 inches high x 9 inches wide x 6 feet-0 inches long, with chamfered top corners and drainage slots underneath for vehicles (please refer to plans). Unit shall weigh minimum 190 lbs.**
   3. Anchor Rods: Two (2) No. 4 by 12-inch-long anchor rods located approximately 12 inches from each end of wheel stop.
   4. Epoxy Adhesive: As specified under concrete materials above.

K. ADA Detectable Warning Paver
   1. As produced by Pavestone or approved Equal.
   2. Color as approved by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review approved mix designs with Architect in field.

B. Clean all mixing and transportation equipment; remove debris from forms; wet forms thoroughly; remove ice and other coatings from reinforcement which might hinder good bond; remove water from place of deposit; and check reinforcement.

C. Inspection: Examine all areas and conditions under which the Work of this Section will be performed. Correct any conditions detrimental to the approved completion of the work. Do not proceed until all such conditions are corrected.

D. If thickness of concrete pavement is not labeled on the drawings, the thickness shall be 6-inch thick.

3.2 INSTALLATION

A. Forms:
1. Conform to the shapes, lines and dimensions of the members as shown on the drawings, except as modified under the Earthwork Section of these specifications. Review depths with Architect in field.
2. Care shall be taken to assure that formwork does not stain concrete surfaces.
3. Slab Block-Outs:
   a. Diamond configuration at paving drains, round or diamond configuration at bollards, fence posts and the like.
   b. Coordinate with concrete joints, verify with Architect.
4. Slope exterior concrete slabs away from building and towards paving drains. Verify all slopes with Architect prior to start of concrete pour.
5. Form Removal:
   a. Remove only after concrete has thoroughly hardened.
   b. Vertical forms for ground-supported slabs may be removed 24 hours after pour.

B. Reinforcing:
1. Cleaning Reinforcement: Free from rust, scale, dirt, or other coatings which will destroy or reduce the bond.
2. Placing Reinforcement:
   a. Place accurately and adequately secure in position.
   b. Bar reinforcement in all concrete slabs shall be held in proper locations by use of plastic chairs spaced a maximum distance of 36 inches on center unless noted otherwise.
3. Coverage of Reinforcement: The metal reinforcement shall be protected by the thickness of concrete indicated on the plans.
   a. Three (3) inches: Concrete deposited against ground without use of forms.
   b. Two (2) inches: Bars more than 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
   c. 1-1/2 inches: Bars 5/8-inch diameter where concrete is exposed to the weather or exposed to the ground but placed in forms.
   d. Two (2) inches: In slabs and walks on grade.
   e. 1-1/2 inches-1-3/4 inches from top: Paving

C. Joints:
1. Construction Joints:
   a. Shall occur at expansion joints.
   b. Use at cold joints in paving slabs.
2. Expansion Joints:
   a. Locate fiber joint filler type where walks and paving abut curbs and at perimeter of slab infill. Joints shall be continuous and full depth and width of slab. Stop 3/4-inch-thick fillers 1/2 inch below top of paving and 1/2-inch-thick fillers 3/8 inch below top of paving for subsequent application of sealant cap; sealant to be applied to within 1/8 inch of slab surface. Verify other locations with Architect where asphalt impregnated fiber joint filler and sealant cap is to be used.
   b. Locate redwood expansion joints at paving and walk expansion joints where indicated, complete with load transfer units as specified herein and detailed. Joints shall be continuous and full depth and width of slab. Except where detailed without sealant cap, stop expansion joints 1/2 inch below top of paving for subsequent application of sealant cap. Top surface of sealant shall be approximately 1/8 inch below top of adjacent concrete. Install sealant in accordance with manufacturer's instructions. For applications where no sealant cap is to be applied, stop expansion joints 1/8 inch below top of paving surface. Verify other locations with Architect where redwood expansion joint and sealer cap is to be used.

c. Install redwood expansion joints 5 feet either side of water lines under pavement.

3. Load Transfer Units: Install straight and true, and in accordance with manufacturer's instructions.
4. Tooled Joints:
   a. Steel tool all control joints, edges of expansion joints, and all exposed perimeter edges to smooth bullnose, using an edger having a radius of 1/4 inch, as approved.
   b. Form control joints in uniform straight lines in locations indicated, but in no case greater than 5 feet apart, uniformly spaced.

D. Accessories: Install accessories and boxes, sleeves and other required devices furnished by other trades.

E. Concrete:
1. Conveying:
   a. Batching, mixing and Delivery Equipment: Use transit mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to the site in accordance with provision of ASTM C94.
   b. Where colored concrete is shown or required, i.e. accessible ramps, use color pigment admixture in concrete. Mix color pigment into concrete in accordance with manufacturer's recommendations to achieve integrally pigmented concrete in specified colors or as selected by Architect.
   c. Handling concrete from point of delivery and transfer to conveying equipment and to location of final deposit as rapidly as practicable and by methods which prevent segregation and loss of mix materials.
   d. Provide runways for wheeled conveying equipment from delivery point to location of final deposit.
   e. Keep interior surfaces of conveying equipment, including chutes and tremies, free from hardened concrete, debris, water and other deleterious materials.
   f. Pumps may be used only if they can pump the mix designed. Do not add fine aggregate or water to the mix to satisfy needs of a pumping device.
   g. Use chutes or tremies for placing concrete where a drop of more than 6'-0" is required.
   h. Addition of water on the job - The maximum water-cement ratio should never be exceeded. If all the water allowed by the specification has not been added at the start of mixing, it may be permissible to add the remaining allowable water at the point of delivery.

2. Concrete Placement, General:
   a. Place concrete in compliance with practices and recommendations of ACI 304, and as specified herein.
   b. Do not deposit concrete on concrete which has hardened sufficiently to form seams or planes of weakness within the section.
   c. Sections between expansion joints shall be placed in continuous pours; construction joints in paving and walks other than at expansion joint locations will not be permitted.
   d. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
   e. Deposit concrete as nearly as practicable in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which might cause segregation.
   f. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming and grouting.

g. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials.

3. Slab Placement:
   a. Moisten subgrade the evening before and immediately prior to placement of all paving slabs.
   b. Deposit and consolidate concrete slabs in a continuous operation, within the limits of all expansion joints, until the placing of a panel or section is completed using vibrating bridge screeds, roller pipe screeds or other methods acceptable to Architect.
   c. Consolidate concrete during placement by use of the specified equipment, preferably with power driven floats of impact type, thoroughly working concrete around reinforcement and into corners.
   d. Bring slab surfaces to correct level with a straight edge, and then strike off.
   e. Use bull floats or darbies to smooth the surface, leaving it free from bumps and hollows.
   f. Do not sprinkle water on the plastic surface; do not disturb the slab surfaces prior to start of finishing operations.
4. Extruded Curb Placement:
   a. Install to detail in locations shown.
   b. Apply epoxy resin adhesive to paved surface prior to extruding curb.
   c. Machine extrude concrete to shape detailed on Drawings, as approved. Trowel form concrete curbs in areas where machine cannot reach.
   d. Install pre-molded expansion joints where curbs meet poured-in-place concrete and at 60 lineal feet maximum spacing; elsewhere where indicated.
   e. Cut crack control joints every 20 lineal feet and at beginning of curves with less than five (5) foot radius.
   f. Hand trowel rough areas to a dense, uniform texture. Bevel curbs 45 degrees at dead ends.
   g. Spray apply membrane forming curing compound after curb installation.
   h. Remove and replace curbs which crack; cut out chipped or cracked areas and reinstall new extruded curbs.
   i. Remove excess concrete from paving surfaces.

F. Curing:
1. General:
   a. Protect all freshly placed concrete from premature drying and excessive hot or cold temperature extremes. Start curing procedures on slabs immediately after finishing operation.
   b. Maintain curing procedures for seven (7) days at minimum temperature of 50 degrees F.; if mean daily temperature drops below 40 degrees F. during this period, extend curing period an equal number of days or provide temporary heat or additional protection to maintain specified minimum temperature of air in contact with concrete.
2. Curing Exterior Paving and Slabs: Spray paving, walks, curbs and other miscellaneous slabs with liquid membrane-forming compound specified above, applied at not less than the manufacturer's specified and recommended rate.

G. Finishes:
1. Spreading of dry cement for finishing is not permitted.
2. Finish all exposed edges and joints with edging tools of 1/4 inch radius.
3. Exterior Paving and Slabs:
   a. Floating: Do not begin floating until bleed water sheen has disappeared or until leveled material has stiffened sufficiently for power floating. After power floating, re-

float by hand immediately to uniform, true, smooth, granular surface within the specified tolerance.

b. Medium Broom Finish: Broom after floating and concrete is hard enough to retain scoring. Use a stiff fiber or wire broom. Broom perpendicular to direction of traffic, typically. Broom in opposite directions at sidewalk panels in a checkerboard pattern or as indicated on drawings.

4. Handicapped Accessible Ramps: Slope surfaces as shown on drawings. Texture ramp by providing raised, truncated domes on the surface of the ramp in accordance with TAS.
   1) New Concrete Ramps: Integrally color concrete in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
   2) Existing Concrete Ramps: Stain concrete using specified concrete stain in color selected by Architect from manufacturer's standard colors to provide contrasting color to that of adjacent concrete.
      a) Prior to applying any stain, existing concrete ramps shall be cleaned up of all dirt, oil, grease, and other contaminates.
      b) Acid etch with 25 percent muriatic acid solution.
      c) Power wash at 3,000 psi.
      d) Water test to determine if water absorbs, thereby making it good to stain.
      e) Allow concrete to thoroughly dry.
      f) Apply stain in accordance with manufacturer's instructions.

      Note: All colors must be approved by Architect prior to their use. Failure to do so, may be cause for rejection of work and removal and replacement of work with new work at Contractor's expense.
5. Miscellaneous Vertical Surfaces: Finish all vertical surfaces, including but not limited to curbs, risers, low walls and stringer, while concrete is strong enough to stay in place without forms yet green and able to be finished to a homogeneous appearance.

H. Traffic Lane, Parking Space, and Zone Paint Striping: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect paint bond.
2. Allow concrete surfaces to cure the minimum time recommended by the traffic marking paint manufacturer, but in no case less than 30 days prior to applying traffic marking paint.
3. Locate markings as indicated on drawings. Do not apply paint until layout is verified with Architect. Protect surfaces which are not to receive paint.
4. Mix paint and apply in accordance with manufacturer's instructions, using skilled labor and proper mechanical equipment to produce uniform, straight lines without bleeding edges or runs.
5. Paint traffic, parking lanes, and accessibility handicapped parking lines as shown on drawings and to comply with requirements of authorities having jurisdiction.
6. Paint curbs and stenciled signs for FIRE LANES, NO PARKING, and BUS LOADING areas, crosswalks, handicapped accessible parking spaces, and other areas shown on drawings or required by authorities having jurisdiction. Use proper type, style and size stencils for all numbers and lettering. Do not apply paint until layout is verified with Architect and/or authorities having jurisdiction. Protect surfaces which are not to receive paint.

I. Precast Concrete Wheel Stops: (As shown on drawings or required)
1. Surface Conditions: Clean and dry, free from dirt, loose paint, oil, grease, wax and other surface contaminants which would affect epoxy bond.
2. Locate wheel stops as indicated on drawings.
3. Predrill holes in concrete paving for anchor rods.
4. Secure wheel stops in 1/8-inch-thick x 3-inch-wide epoxy and drive anchor rods through predrilled holes filled with epoxy grout.

J. ADA Detectable Warning Paver
   1. Install per manufacturer's details and requirements.

3.3 FIELD QUALITY CONTROL

A. Inspection and Testing Laboratory:
   1. Perform the appropriate tests upon notification by the Contractor.

B. Tolerances:
   1. Slope as shown on drawings.
   2. Paving sections containing "bird baths" greater than two (2) feet in diameter or 1/8 inch deep (regardless of the size of the area) will be removed and re-poured at the Contractor's expense.

3.4 PATCHING AND CLEANING

A. Clean exposed concrete surfaces and adjoining work stained by concrete leakage to the Architect's approval.

B. Reinforce or replace all deficient work as directed by the Architect and at no additional cost to the Owner.

C. Clean all concrete and cement work upon completing this portion of the work.

3.5 DEFECTIVE WORK

A. Imperfect or damaged work, as determined by the engineer, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.6 PENALTY FOR DEFICIENT PAVEMENT THICKNESS

A. It is the intent of this specification that the pavement be constructed in strict conformity with the thickness and typical sections shown on drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

B. Prior to final acceptance, and if deemed necessary by the Engineer, the pavement will be cored by the Testing Laboratory. Locations of core tests may be selected by the Engineer. Regular testing shall occur for every five hundred (500) square yards of placed concrete pavement and at random locations.

C. For the purpose of establishing an adjusted price for pavement, units to be considered separately are defined as 500 square yards of pavement.

D. One core will be taken at locations selected by the Engineer or at random in each unit and tested in accordance with ASTM Method C-174. When measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made.

E. If the measurement of any core from any unit is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, two additional cores will be taken from the unit, and the average of the three cores will be determined. The two additional cores will be taken so that the unit will be well represented. If the average thickness of the three cores is deficient more than 0.2 inch but not more than 0.50 inch from the plan thickness, an adjusted unit price as provided below, will be paid

for in these areas represented by these cores. At the option of the Engineer, additional cores may be taken in the adjacent unit/units to determine if the deficiency of thickness continues across all lanes of pavement. If the deficiency exists in one (1) or more adjacent units, adjusted unit prices as provided below will be paid for those adjacent units that are found to be deficient.

F. Price Adjustments: Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores (in inches)	**Proportional Part of Contract Price Allowed (adjustment factor)**
No deficient	1.0
Over 0.00 through 0.20	1.0
Over 0.20 through 0.30	0.80
Over 0.30 through 0.40	0.72
Over 0.40 through 0.50	0.68
Over 0.50	0.50 or removal*

*At the option of the Engineer.

G. Any area of pavement found deficient in thickness by more than 0.50 inch but not more than 0.75 inch shall be evaluated by the Engineer. If, in the judgement of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings. Any area found deficient in thickness by more than 0.75 inch shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness shown on the drawings.

H. No additional payment over the contract price will be made for any pavement of a thickness exceeding that required on the drawings. Also, planing of concrete pavement shall not be allowed.

END OF SECTION 32 13 13

SECTION 32 18 23.30 - INFILLED MONOFILAMENT SYNTHETIC TURF SYSTEM

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.1 WORK INCLUDED

A. Furnish all labor, materials, tools and equipment necessary to install all synthetic turf as indicated on the plans and as specified herein. The installation of all new materials shall be performed in strict accordance with the manufacturer's installation instructions and in accordance with all approved shop drawings.

B. Perimeter edge details required for the system shall be as detailed and recommended by the Manufacturer, and as approved by the Owner.

C. It is the intent of this Section that the Work shall include, but not be limited to:
   1. Sports field construction, and related materials and accessories shown on Drawings or required to complete Work.
   2. Work shall be performed and warranted by a single source supplier/contractor.

1.2 RELATED SECTIONS

A. Section 32 11 23.23 Free-Draining Stone Base for Synthetic Turf System

1.3 REFERENCES

A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition

B. ASTM Standard Test Methods:
   1. D1577 Standard Test Method for Linear Density of Textile Fiber
   2. D5848 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
   3. D418 Standard Test Method for Testing Pile Yarn Floor Covering Construction
   4. D1338 Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
   5. D1682 Standard Method of Test for Breaking Load and Elongation of Textile Fabrics
   6. D5034 Standard Test Method of Breaking Strength and Elongation of Textile Fabrics
   7. F1015 Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
   8. D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity
   9. D2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
   10. F355 Standard Test Method for Shock-Absorbing Properties of Playing Surfaces.
   11. F1936 Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
   12. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

   B. UIL, NFHS and/or NCAA rules/regulations, latest edition.

1.4 SUBMITTALS

A. See Section 01 33 00 - Requirements for submittal procedures.

B. Prior to the Architect approval of a specified synthetic turf system, the Manufacturer shall specify in writing that their turf system does not violate any other manufacturer's patents, patents allowed or patents pending.

C. Submit the following with the Proposal:
   1. Submit two (2) “dry” turf samples, 12”x12” in size, of the specified turf product.
   2. A letter and specification sheet certifying that the products of this section meet or exceed specified requirements.
   3. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
      a) Pile Height, Face Width & Total Fabric Weight, ASTM D418 or D5848
      b) Primary & Secondary Backing Weights, ASTM D418 or D5848
      c) Tuft Bind, ASTM D1335
      d) Grab Tear Strength, ASTM D1682 or D5034
      e) Pill Burn Test ASTM D2859
      f) Flooring Critical Radiant Panel Test (Flame Spread) ASTM E-648
   4. List of existing installations, including Owner representative and telephone number.
   5. Lists providing specific contacts and telephone numbers of the following:
      a) A minimum of 5 fields using the specified fiber and infill, in play for at least 5 years. These installations must have used the same manufacturer, product and company they are proposing for this field.
      b) A list of a minimum of 5 UIL and/or NCAA sports fields (of the type of sports field; ie. football, soccer, etc.) installed by the company in play for at least 5 years.
      c) A list of at least of 5 fields of 65,000 square feet or more in North America with the same manufacturer, product and company, including the exact same fiber and infill system that is being proposed for this field that have been in play for at least 5 years. Provide owner contact names and numbers and dates of install.
   6. Resume of Installation Supervisor who will be present on site during installation.
   7. The Contractor and the turf Manufacturer (if different from the company) shall, if requested by the Owner or Owner’s representative, provide a current audited company financial statement. The Owner shall put in writing that this information shall be held in confidence and not shared with third parties.
   8. The Contractor and Turf Manufacturer (if different from the company) shall provide evidence that their turf system does not violate any other manufacturer's patents, patents allowed or patents pending.
   9. The Contractor and the Turf Manufacturer (if different from the company) shall provide a copy of insured, non-prorated warranty and third party, non-cancelable insurance policy information, as detailed in these documents. The work cannot commence until the 8-year policy documentation is submitted and approved.

D. Prior to ordering of materials:
   1. The Contractor shall submit Shop Drawings indicating:
      a. Field Layout
      b. Field Marking Plan and details for the sport field(s) shall meet UIL, NFHS, and/or NCAA rules/regulations (latest edition).
      c. Roll/Seaming Layout
      d. Methods of attachment, field openings and perimeter conditions.
   2. The turf Manufacturer must submit the fiber manufacturer's name, type of fiber and composition of fiber.

E. Prior to Final Acceptance, the Contractor shall submit to the Owner:
   1. Two (2) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and markings.
   2. Project Record Documents: Record actual locations of seams, drains or other pertinent information.
   3. Warranty: Submit Manufacturer Warranty and ensure that forms have been completed in Owner's name and registered with Manufacturer.
   4. Warranty Insurance Policy Certificate must match or exceed the requirements outlined in the contract documents, be a minimum 8 year policy, be executed prior to Final Payment, and the Policy must be prepaid for full 8+ year term.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section. The Turf Contractor and/or the turf Manufacturer:
   1. Must be experienced in the manufacture and installation of this specific type of synthetic infill turf system for at least 5 years with the same manufacturer, product and company they are proposing for this field. This includes the same pile fiber, the backing, the backing coating, and the installation method.
   2. Must have at least 5 fields of 65,000 square feet or more of the exact specified material, including the infill material and fiber, in play for at least 5 years with the same manufacturer and company they are proposing for this field.

B. Installer Qualifications: Company specializing in performing the work of this section.
   1. The Contractor must provide competent workmen skilled in this specific type of synthetic turf installation. Technicians must have installed specified type of turf system on at least 10 fields of 65,000 square feet or more within the past 3 years.
   2. The designated Supervisory Personnel on the project must be certified, in writing by the Turf Manufacturer, as competent in the installation of this material, including sewing/gluing seams and proper installation of the infill mixture.
   3. The Manufacturer shall have a representative on site to certify the installation and Warranty compliance.

C. Prior to the beginning of installation, the Installer of the synthetic turf shall inspect the sub-base. The installer will accept the sub-base in writing when the contractor provides test results for planarity and permeability that are in compliance with the synthetic turf manufacturer's guidelines. The Installer shall have the dimensions of the field and locations for markings measured by a registered surveyor to verify conformity to the specifications and applicable standards. A record of the finished field as-built measurements shall be made. The final tolerance-to-grade of the base shall not exceed ±¼ inch in ten feet in any direction.

D. The Contractor shall provide the necessary testing data to the owner that the finished field meets the required shock attenuation, as per ASTM F1936.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to project site in wrapped condition.

B. Store products under cover and elevated above grade.

1.7 WARRANTIES

A. See Section 01 77 99 – Closeout Procedures for additional warranty requirements.

B. The contractor and Turf Manufacturer shall provide a Warranty to the owner that covers defects in materials and workmanship of the synthetic turf system for a period of 8 years from the date of Substantial Completion. The turf manufacturer must verify that their onsite representative has inspected the installation and that the work conforms to the manufacturer's requirements.

C. The Manufacturer's Warranty shall include general wear and damage caused from UV degradation. The warranty shall not be prorated. The warranty shall specifically exclude vandalism, and acts of God beyond the control of the owner or the manufacturer.

D. The Manufacturer's Warranty must be supported by a third party, non-cancelable, non-prorated insurance policy for the full eight (8) year period. The policy must be from an A Best Rated company and be paid in full for the 8-year term.

E. The Contractor shall provide a Warranty to the owner that covers defects in the installation workmanship, and further warrant that the installation was done in accordance with both the Manufacturer's recommendations and any written directives of the Manufacturer's onsite representative.

F. The synthetic turf for the football/soccer fields must maintain throughout the 8-year warranty period an ASTM F-355-10a, G-max of between 100-160. The contractor shall pay for a third party G-max testing of field upon completion of field installation. If at any point during the 8-year warranty period the field is G-Max tested and does not meet the specified requirements, the turf contractor and/or manufacturer shall reimburse the owner for the test cost and shall make the necessary improvements to the field to bring into the specifications.

1.8 MAINTENANCE SERVICE

A. The Contractor will train the Owner's facility maintenance staff in the use of the Turf Manufacturer's recommended groomer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers (turf systems) are as follows. All manufacturers' turf systems must meet the properties outlined in Section 2.2.:
   1. AstroTurf 3DM - (52-ounce face weight; 2" pile height as measured in the field)
   2. Fieldturf Prestige XM – (40-ounce face weight; 2.25" pile height as measured in the field)
   3. Hellas Matrix - (46-ounce face weight; 2.25" pile height as measured in the field)
   4. Paragon Powerblade Pro - (43-ounce face weight; 2.25" pile height as measured in the field)

2.2 MATERIALS

A. The component materials of the synthetic turf system consist of:
   1. A Carpet made of polyethylene monofilament fibers tufted into a fibrous, porous backing. ***The fibers shall be a C8 grade polyethylene***.
   2. An Infill that is a controlled mixture of graded sand and rubber crumb that partially covers the carpet.
   3. Glue, thread, seaming fabric and other materials used to install and mark the artificial grass field turf.

B. The installed artificial grass field turf shall be a slit-film fiber having the following properties:

Standard	Property	Specification
ASTM D1577	Fiber Denier	10,800 nominal
ASTM D1577	Fiber Thickness	260 microns
ASTM D418/D5848	Pile Height	2.25" minimum (unless noted otherwise)
ASTM D418/D5848	Pile Weight	Ref. 2.1.A.
ASTM D1335	Tuft Bind	8 lbs. (without infill)
ASTM D1682/D5034	Grab Tear (width)	>200 lbs/force
ASTM D1682/D5034	Grab Tear (length)	>200 lbs/force
ASTM F1015	Relative Abrasiveness Index	20
ASTM D4491	Carpet Permeability	>40 inches/hour
ASTM D2859	Flammability (Pill Burn)	Pass
ASTM E648	Critical Radiant Flux	>.2 g/sq.cm. (Class B)
ASTM F355/F1936	Impact Attenuation (Gmax)	100 - 160 over field life (8+ years)

C. The Carpet shall consist of fibers tufted into a primary backing with a secondary elastomeric coating.
   1. The Carpet shall be furnished in 15' wide rolls. Rolls shall be long enough to go from sideline to sideline without splicing. The perimeter white line shall be tufted into the individual sideline rolls. Head seams, other than at sidelines, will not be acceptable
   2. The Carpet's primary backing shall be a composite fabric treated with UV inhibitors, consisting of multiple layers of woven polypropylene and non-woven polypropylene needle punched together so as to function as a single unit. The secondary back coating shall consist of an application of heat-activated urethane to permanently lock the fiber tufts in place.
   3. The fiber shall be 10,800 denier, 260 microns thick, low friction, UV-resistant fiber measuring not less than 2 ½ inches high (unless noted otherwise).

D. The Infill materials shall be approved by the Manufacturer. The Infill shall consist of a resilient layered granular system, comprising selected and graded dust-free silica sand and cryogenically ground (hammer-milled) or dust free ambient SBR rubber crumb.

E. Threaded and/or glued seams as well as the method and adhesives used for inlaid markings shall be as recommended by the synthetic turf manufacturer.

F. If the turf system being submitted is not able to meet the required G-max for the specified warranty period, the turf manufacturer must install a shock pad shall as follows:
   1. Factory made rubber shock pad (Regupol or equal), comprised of recycled SBR granules bound by polyurethane under heat and pressure. Thickness shall be a minimum 10mm. Joints shall be seamed properly per the manufacturer's recommendation. Provide detailed specifications with the proposal.
   2. In situ SBR rubber granule pad bound by polyurethane (elastic layer). Polyurethane shall comprise at least 7% of the mix. Thickness of elastic layer pad, which must be installed using suitable equipment designed for the application (P700), shall be a minimum 19mm. System must include a percentage of gravel in the mix to provide sufficient weight and density). Provide detailed specifications with the Bid.
   3. Porous, synthetic shock pad having a minimum thickness of 14mm, by Brock or preapproved equivalent.
   4. Preapproved equivalent shock pad.

2.3 FIELD SWEEPER & FIELD GROOMER

A. Supply a field sweeper/groomer, which shall include a towing mechanism compatible with a field utility vehicle. The field sweeper/groomer shall be an "SMG TurfCare TCA1400" (or approved equivalent) Synthetic Sweeper/Groomer with 72" tow-behind magnet.

PART 3 EXECUTION

3.1 GENERAL

A. The installation shall be performed in full compliance with approved Shop Drawings.

B. Only trained technicians, skilled in the installation of athletic caliber synthetic turf systems working under the direct supervision of the approved installer supervisors, shall undertake any cutting, sewing, gluing, shearing, topdressing or brushing operations.

C. The designated Supervisory personnel on the project must be certified, in writing by the turf Manufacturer, as competent in the installation of this material, including sewing seams and proper installation of the Infill mixture.

D. All designs, markings, layouts, and materials shall conform to all currently applicable UIL, NFHS, and/or NCAA rules and other standards that may apply to this type of synthetic grass installation.

E. If an Elastic Layer shock pad system is required, it must be installed using proper paving equipment (SMG P700, modified for the application), and the crew must be experienced in this application.

3.2 EXAMINATION

A. Verify that all sub-base, drainage and leveling is complete prior to installation.

B. The surface to receive the synthetic turf shall be inspected by the Installer, and prior to the beginning of installation, the Installer must accept the sub-base in writing. The acceptance will depend on the contractor providing the installer with test results indicating that planarity and permeability are in compliance with the synthetic turf manufacturer's written guidelines or recommendations. The surface must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.

C. The compaction of the aggregate base shall also be accepted in writing by the Turf Installer, and the surface tolerance-to-grade shall not exceed $\pm$1/4 inch over 10 feet.

3.3 INSTALLATION

A. Install in accordance with Manufacturer's instructions. The Contractor shall strictly adhere to his installation procedures outlined under this section. Any variance from these requirements must be accepted in writing, by the Manufacturer's onsite representative, and submitted to the Architect/Owner, verifying that the changes do not in any way affect the warranty. Infill materials shall be approved by the Manufacturer and installed in accordance with the Manufacturer's standard procedures.

B. If a shock pad is required, the pad shall be Installed per these specifications and per the manufacturer's installation procedures using only approved and suitable equipment and skilled technicians experienced in the installation of elastic layer or factory-made pads. In situ pads must be allowed to cure for a minimum 24 hours.

Repairs to an existing shock pad shall be performed per these specifications and per the manufacturer's installation procedures using only approved and suitable equipment and skilled technicians experienced in the installation of elastic layer. The shock pad repairs must be allowed to cure for a minimum 24 hours.

B. The carpet rolls are to be installed directly over the properly prepared aggregate base or shock

pad. Extreme care should be taken to avoid disturbing the aggregate base, both in regard to compaction and planarity. It is suggested that a 2-5 ton static roller is on site and available to repair and properly compact any disturbed areas of the aggregate base.

D. The full width rolls shall be laid out across the field. Turf shall be of sufficient length to permit full cross-field installation from sideline to sideline. No head or cross seams will be allowed in the main playing area between the sidelines. Utilizing standard state of the art sewing or gluing procedures each roll shall be attached to the next. When all of the rolls of the playing surface have been installed, the sideline areas shall be installed at right angles to the playing field turf.

E. All seams shall be sewn using double bagger stitches and polyester thread or adhered using seaming tape and high grade adhesive (per the manufacturer's standard procedures). Seams shall be flat, tight, and permanent with no separation or fraying.

F. Infill materials shall be applied in numerous thin lifts. The turf shall be brushed as the mixture is applied. The infill material shall be installed to a depth determined by the Manufacturer, but not less than 75% the pile height of the turf. Should the infill depth ever fall below 70% the pile height of the turf during the 8-year warranty period, the turf contractor shall install new crumb rubber infill at his expense.

G. The Infill materials shall be installed to fill the voids between the fibers and allow the fibers to remain vertical and non-directional. The Infill installation consists of a base layer of sand followed by a homogenous mixture of the sand and the cryogenically processed rubber. A final application of specifically sized cryogenic or ambient rubber completes the system.

H. Synthetic turf shall be attached to the perimeter edge detail in accordance with the Manufacturer's standard procedures using non-corrosive fasteners.

3.4 FIELD MARKINGS

A. The field will have the following lines and markings tufted or inlaid according to UIL, NFHS, and/or NCAA standards:

1. Football: as shown on the contract drawings and rendering. Color shall be white, except where noted.
   a) Side lines
   b) End lines
   c) 5-yd lines
   d) Goal lines
   e) Numbers w/ arrows
   f) 1-yd hash marks
   g) Tics
   h) Inbound hash marks
   i) Kickoff markings
   j) Center logo
   k) Endzone lettering – Cougars in white lettering surrounded by red turf.

2. Soccer: as shown on the contract drawings. Final color shall be yellow as selected by owner.
   a) All lines and markings.

3. Baseball/Softball: as shown on the contract drawings. Color(s) shall be verified with Owner.
   a) 4" square tick marks for infield base and pitchers plate layout
   b) Batter and catchers boxes.

B. Standards
   1. Standards; all lines and markings shall meet UIL, NFHS, and/or NCAA Standards for the State of Texas.

3.5 CLEANING

A. Protect installed turf from subsequent construction operations.

B. Do not permit traffic over unprotected turf surface.

C. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.

D. All usable remnants of new material shall become the property of the Owner.

E. The Contractor shall keep the area clean throughout the project and clear of debris.

F. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 32 18 23.30

SECTION 32 31 11- GATE OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS

A. Product Data:
   1. Manufacturer's schedules, charts, literature, and illustrations indicating the performance, fabrication procedures, product variations and accessories indicating material compliance and specified options.
   2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MOTOR OPERATION FOR SLIDING GATES

A. Electric gate operation:
   1. Gate to be operated by Model 222 SS 1 HP, Hydraulic operator. All components of the manual override shall be securely enclosed and locked in a 10 gauge steel enclosure.
   2. 1 HP – 230volt - Single Phase
      a. Operator tested to UL 325 standards.
      b. Limit switchs readily adjustable with normal hand tools Securely locked in place after adjustment – switch contacts rated 6 amps.
      c. Spring-loaded friction feed type drive mechanism, consisting of two drive wheels, a manual toggle-style disconnect to instantly disengage the drive wheels for manual operation.
      d. Gate speed – 1.2 fps.
      e. Drive rail 6061-T6 aluminum, 3/16" thick.

B. Controls:
   1. Full Systems Capability
   2. Inherent Obstruction Sensing
   3. External Obstruction Sensing
   4. Obstruction Sensing Alarm
   5. Master/Slave Operation (required for double gates)
   6. Gate Movement Warning
   7. Long Distance Control Wiring
   8. Solenoid-Activated Brake
   9. Safety Loop Connections
   10. Delay on Reverse
   11. On/Off Switch
   12. Limit Switches
   13. Left Hand/Right Hand Selectable
   14. Automatic Shut Down
   15. Timer to Close
   16. Emergency One Button Control Station
   17. Power Train Disconnect

2.2 ACCESS CONTROL EQUIPMENT

A. Card reader systems
   1. Programmable stand-alone.
   2. Computer programmed (Windows software available).
   3. Proximity type (No-Touch).

B. Intercom for voice communication.

C. Hard wired control stations of all types lockout switches and best-cored key switches available.

D. Hold open key switches.

E. Hardwired detection devices for “free exit”
   1. Loop detectors.

F. Radio Frequency Devices
   1. Receivers.
   2. Transmitters.
   3. Keypads.
   4. Multiple channels.
   5. Programmable In or Out of system.
   6. Long Range.
   7. Key chain type.
   8. Passive Identification Devices.

G. Emergency Vehicle Access (Fire, Police, etc.)
   1. Strobe detector.
   2. Siren Operated.
   3. Police band RF operated.

H. Digital lighted keypads- choose one to suit your application
   1. Stand-alone.
   2. Computer programmed.
   3. Multiple security levels.
   4. With Intercom.
   5. Wireless.

F. Printers (for access tracking).

2.3 GATE SAFETY

A. Gate edges to reverse or stop the gate.

B. Magnetic vehicle detectors.

C. Yellow strobe lights.

D. Audible warning.

E. Signage warning signs custom language types available.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify areas to receive fencing are completed to final grades and elevations.

B. Ensure property lines and legal boundaries of work are clearly established.

3.2 INSTALLATION

A. Install in a workmanlike manner in conformance with manufacturer's printed instructions and details.
Anchor or install electric operator on a concrete foundation. Using 1/2x41/2 Hilti Quick bolt concrete stud type anchors.

B. Have at least 2 years previous experience in gate operator installations.

C. Installer must provide service after the sale and be able respond in a reasonable time should trouble occur.

D. Installer must provide references from job of a like nature.

E. Must provide drawings showing layout and typical locations for all equipment that is being supplied.

F. License electrician must perform all electrical connections.

G. Supply electrical power to operator through its own dedicated circuit breaker.

3.3 CLEANING

A. Clean up debris and unused material, and remove from the site.

B. Operators are intended for use in controlling vehicular traffic and are not intended to be used by pedestrians or to control pedestrian traffic. Always install a separate pedestrian man gate.

END OF SECTION 32 31 11

SECTION 32 31 19 – WROUGHT IRON FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:
1. Steel ornamental fences with solid steel pickets.
2. Pedestrian gates.

B. Related Sections include the following:
1. Division 2 Section "Earthwork" for filling and for grading work.
2. Division 3 Section "Cast-in-Place Concrete" for concrete post footings.

1.3 DEFINITIONS

A. Comparable Product: Product demonstrated and approved through submittal process, or where indicated as a produce substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.4 SUBMITTALS

A. Submit product data in the form of manufacturer's technical data, specifications, and installation instructions for fences and gates.

B. Shop Drawings: Submit shop drawings showing location of fence and gates, including each post, details of post installation, hardware, and accessories. Show sizes and thicknesses of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work, and other pertinent details of fabrication and installation.

C. Samples for Verification: Submit samples for each profile and pattern of fabricated metal and for each type of metal finish required, prepared on metal of same thickness and alloy indicated for the Work. Include samples of the following:
1. Post cap including 12 inch (300-mm) long section of post.
2. Full-size sample of fence, 2 feet wide by full height.
3. Gate hardware including hinges and latch.

D. Qualification Data: Submit qualification data for fabricator.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Arrange for installation of ornamental metal fences and gates specified in this Section by the same firm that fabricated it.

B. Fabricator Qualifications: A firm experienced in producing ornamental metal fences and gates similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.6 REFERENCES

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.

C. ASTM D523 - Test Method for Specular Gloss.

D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.

E. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

F. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

G. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

I. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

J. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.7 WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase

PART 2 - PRODUCT

2.1 MANUFACTURER

A. Provide ornamental metal fences and gates as manufactured by Montage II – Heavy Industrial Steel Ornamental Fence System as manufactured by Ameristar Fence Products, Inc. (918) 835-0898 or comparable product approved by the Architect.

2.2 MATERIALS

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90.

B. Material for pickets shall be 1” square x 14 Ga. tubing. The rails shall be steel channel, 1.75” x 1. 75” x .105”. Picket holes in the rail shall be spaced 4.715” o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.3 FABRICATION, GENERAL

A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar’s proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).
1. Color: Architect to select from manufacturer’s full range.

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates shall be fabricated using 1.75” x 14ga Forerunner double channel rail, 2” sq. x 12ga. gate ends, and 1” sq. x 14ga. pickets. Gates that exceed 6’ in width will have a 1.75” sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6’.

F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48” width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5” x 6” footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5” - 1.375”) and vertical (0 - .5”). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

G. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fences and gates in accordance with approved shop drawings. Do not begin installation and erection before final grading is established.

B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
   1. If not indicated on Drawings, excavate holes for each post 6 to 8 inches in diameter.
   2. Unless otherwise indicated, excavate hole depths not less than 36 inches below the finish grade surface.

C. Setting Posts in Earth: Center and align posts in holes, space as required by manufacturer. Brace terminal post against structure as required.
   1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
      a. Unless otherwise indicated, set top of concrete footings 4 inches below finish grade.

D. Setting Posts in Stone or Existing Concrete:
   1. Core drill 3-1/2 inch diameter holes 9 inches deep.
   2. Clean holes of loose material, insert posts, and fill space around post with exterior erosion-resistant anchoring cement, mixed and placed to comply with manufacturer's written instructions.
   3. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8 inch buildup, sloped away from post.

E. Fence Assembly: Install fully assembled fence sections as indicated on Drawings. Set bottom rail of fence 3 inches above finish grade unless indicated otherwise.

3.2 CLEANING AND PROTECTION

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

PART 4 - TABLES

Table 1 – Minimum Sizes for Montage II Posts

Fence Posts	Panel Height
2-1/2" x 12 Ga.	Up to & Including 6' Height
3" x 12 Ga.	Over 6' Up to & Including 8' Height

Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.

6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14'1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

Table 3 – Montage II – Post Spacing By Bracket Type

Span	For INVINCIBLE® 8' Nominal (91-1/2" Rail)				For CLASSIC, GENESIS, & MAJESTIC 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2" (BB319) 3" (BB320)		Industrial Universal 2.5" (BB302) 3" (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± ½" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"

*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.

END OF SECTION 32 31 19

SECTION 32 92 13 - HYDRO-MULCH SEEDING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this section consists of furnishing all plant, labor, materials, equipment, supplies, supervision and tools and performing all work necessary to top soiling, smoothing, seeding, fertilizing, watering maintenance and cleanups of side slopes, all in accordance with these specifications.

B. The hydro-mulch seeding operations, together with all necessary related work, shall conform to the requirements specified in this section. The area(s) to be hydro-mulch seeded shall be noted in the construction documents.

1.2 MEASUREMENT & PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All seed must meet the requirements of the U.S. Department of Agriculture Rules & Regulations as set forth in the Federal Seed Act and the Texas Seed Law.

B. Type of seed, purity and germination requirements, rate of application and planting dates are as follows:

TABLE I

Type	Application Rate Pounds per Acre	Planting Date
Hulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Unhulled Common Bermuda Grass 98/88	40	Jan. 1 to Apr. 15
Annual Rye Grass, including Gulf	50	Jan. 1 to Apr. 15
Hulled Common Bermuda Grass 98/88	40	Apr. 15 to Oct. 1
Hulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1
Unhulled Common Bermuda Grass 98/88	40	Oct. 1 to Jan. 1

C. Fertilizer shall be water soluble with an analysis of 10 percent nitrogen, 20 percent phosphoric acid and 10 percent potash. Rate of application shall be 500 pounds per acre, except during the period of April 15 through September 1, when the rate shall be reduced to 400 pounds per acre. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State Fertilizer Laws and bearing the name and warranty of the producer.

D. Mulch shall be virgin wood cellulose fiber made from whole wood chips. Within the fiber mulch material, at least 20 percent of the fibers will be 10.7mm in length and 0.27mm in diameter. Rate of application shall be 2000 pounds per acre. Soil Stabilizers such as Terra Type III (or approved equal) shall be applied at a rate of 40 pounds per acre on side slopes and Terra Tack I (or approved equal) shall be applied at a rate of 40 pounds per acre on flatter portions.

E. Wood cellulose fiber mulch, for use in the grass seed and fertilizer, shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to the underlying soil. Weight specifications from suppliers, shall refer only to the air-dry weight of the fiber. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and must be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.

F. Water shall be free from oil, acid, alkali, salt and other substances harmful to the growth of grass. The water source shall be subject to approval, prior to use.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Immediately after the finished grade has been approved, begin hydro-mulching operations to reduce erosion and excessive weed growth.

B. Hydraulic equipment used for the application of fertilizer, seed and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles, which provide even distribution of the slurry on the area to be seeded. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit, which may either be self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded, so as to provide uniform distribution without waste. The Engineer may authorize equipment with a smaller tank capacity, provided the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

C. Care shall be taken that the slurry preparation take place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good re-circulation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-third to three-fourths full.

Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform visible coat, by using the green color of the wood pulp as a guide.

3.2 APPLICATION

A. The Contractor shall obtain approval of hydro-mulch area preparation from the Engineer prior to application.

B. Operators of hydro-mulching equipment shall be thoroughly experienced in this type of application. Apply the specified slurry mix in a motion to form a uniform mat at the specified rate. Operators shall keep the hydro-mulch within the areas designated and keep from contact with other plant material. Immediately after application, thoroughly wash off any plant material, planting areas or paved areas not intended to receive slurry mix.

C. Keep all paved and planting areas clean during maintenance operations. Contractor shall keep hydro-mulching within the areas designated and keep from contact with other plant material.

D. If in the opinion of the Engineer, unplanted skips and areas are noted after hydro-mulching, the Contractor shall be required to seed the unplanted areas with the grasses that were to have been planted at no additional cost to the Owner.

3.3 CONTRACTOR'S MAINTENANCE AND GUARANTEE PERIOD

A. The hydro-mulch seeding shall be adequately watered until established. Any areas damaged by erosion or areas that do not have any acceptable turfing shall be redone to the satisfaction of the Engineer. Maintenance of grass areas shall be for 60 days after the completion of the project and shall consist of watering, weeding, repair of all erosion and reseeding, as necessary to establish a uniform stand of the specified grasses. The Contractor shall guarantee growth and coverage of hydro-mulch planting under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days.

B. Prior to final acceptance, the Contractor shall be responsible for one (1) mowing per month between the months of April to September and shall mow every thirty (30) days plus or minus five (5) after the initial mowing. The Contractor shall also be responsible for one (1) mowing every six (6) weeks between the months of October to March. In addition, the Contractor shall water the entire sodded and hydro-mulched areas to a saturated depth of one (1) inch at least once a week between the months of April to September and at least once a month between the months of October to March.

C. The Contractor shall make a second application of specified hydro-mulch planting to those bare areas not meeting specified coverage as determined by the Engineer. Such replanting is to be performed within 60 days of initial application and upon notification by the Engineer to replant.

D. The Contractor shall apply top dress fertilizer (delayed action), at the rate of 10 pounds per 1000 square feet at 25 days after hydro-mulching of all new lawn areas.

E. Top dress fertilizer shall be 16-6-8.

END OF SECTION 32 92 13

SECTION 32 92 23 - FERTILIZER

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Fertilizing shall consist of providing and distributing fertilizer over such areas as are designated for block sodding or seeding, for erosion control, and in accordance with these specifications.

1.2 MEASUREMENT

A. Acceptable material for "Fertilizer" will be measured by the C-WT (100 lbs) as determined by approved scales or guaranteed weight of sacks shown by manufacturer.

1.3 PAYMENT

A. No separate payment shall be made for materials furnished or work performed under this Section. Include the cost of same in the contract price bid for work of which this is a component part.

PART 2 – PRODUCTS

2.1 MATERIALS

A. All fertilizer used shall be delivered in bags or containers clearly labeled showing analysis. A pelleted or granulated fertilizer shall be used with an analysis of 10-10-5, unless otherwise specified. The figures in the analysis represent the nitrogen, phosphoric acid and potash nutrients respectively as determined by the methods of the Association of Official Agricultural Chemists. The sources of nitrogen in the fertilizer shall be roughly balanced between ammonical (quick release) and nitrate nitrogen (slow release).

B. With permission of the Engineer, fertilizer of a different analysis may be substituted. It shall be pelleted or granulated fertilizer with a lower concentration. The total amounts of nutrients furnished and applied per acre shall equal or exceed that specified for each nutrient.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. When fertilizer is included in the specifications, pelleted or granulated fertilizer shall be applied uniformly over the area specified to be fertilized and, in the manner, directed for the particular item of work. Fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of fertilizer for the particular item of work shall meet the approval of the Engineer.

B. Unless otherwise indicated on the plans, fertilizer shall be applied uniformly at the average rate of 480 pounds per acre when "Sodding for Erosion Control", and 400 pounds per acre when "Seeding for Erosion Control".

END OF SECTION 32 92 23

SECTION 32 92 23.16 - SOLID SODDING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 DESCRIPTION

A. Solid Sodding for erosion control shall consist of providing and planting Bermuda grass, or other acceptable sod along or across such areas as are designated on the plans and in accordance with the specification requirements herein outlined.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. The sod shall consist of live, growing Bermuda grass (ninety-five percent pure), secured from sources where the soil is fertile and has been fumigated. Bermuda sod shall have a healthy virile root system of dense, thickly matted roots throughout and grown in a sandy loam soil consisting of a minimum of 60% sand. Sod grown in fat clayey materials are not acceptable. The sod shall be cut from the field so that there is a minimum of one-half inch of soil on the roots of the sod, and so that no roots show on the bottom of the soil. Sod shall be dense, with the grass having been mowed to 1-inch height before lifting from the field. Sod shall be in a vigorous condition, dark green in color, free of disease and harmful insects. The contractor shall not use sod from areas where the grass is thinned out, nor where the grass roots have been dried out by exposure to the air and sun to such an extent as to damage it stability to grow when transplanted. The sod shall be free from obnoxious weeds or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long-standing stems.

B. Care shall be taken at all times to retain the native soils on the roots of the sod during the process of excavation, hauling and planting. Sod material shall be kept moist from the time it is dug, until planted. When so directed by the Engineer, the sod existing at the source shall be watered to the extent required, prior to excavating. Do not stack sod for more than 36 hours between the time of cutting and the time of installation. The Engineer reserves the right to reject any sod deemed unacceptable for installation.

C. All planting shall be done between the average date of the last freeze in the spring and six weeks prior to the average date for the first freeze in the fall, according to the U.S. Weather Bureau.

D. Fertilizer shall conform to the requirements of SECTION 32 92 23 - FERTILIZER and shall be applied at the rate of 480-pounds per acre.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Immediately after the finished grade has been approved, begin sodding operations to reduce excessive weed growth. If the sod bed is dry immediately prior to sod installation, dampen the surface with a fine mist of water.

B. Grass shall be turf sod, cut into approximately 18 inch wide by 24-inch long pieces, or 18 inch wide by continuous length rolls.

C. All areas to be sodded shall be raked to true lines, free from all unsightly variations, bumps, ridges or depressions. All sticks, stones, roots or other objectionable material, which might interfere with the formation of a finely pulverized seedbed, shall be removed from the soil.

D. Lay sod so that adjacent strips butt tightly, with no spaces between strips. Lay sod on mounds and slopes, with strips parallel to contours. Stagger joints. Tamp and roll the sod thoroughly to make contact with the sod bed, or as directed by the Engineer.

E. Peg sod on slopes three to one or steeper with pegs driven through sod into soil, until pegs are flush with the turf. Space pegs 18 inches on center. Pegs to be 1 inch square, 6 inches long or, 6-inch lengths of lath. Commercial fertilizer as outlined in SECTION 32 92 23 - FERTILIZER shall be applied to the entire sodded area at the prescribed rates, immediately following laying of the sod. Immediately after fertilizing, water the entire area to a saturated depth of 2-inches.

F. Immediately after installation of the sod, remove sod clumps on soil, wash off any plant materials and pavements not to have sod. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until accepted.

3.2 CONTRACTOR'S MAINTENANCE AND GUARANTEE PERIOD

A. Maintenance of sodded areas shall be for 60 days after completion of the project and shall consist of watering, weeding, repair of all erosion and resodding as necessary to establish a uniform growth of the specified grass. The Contractor shall guarantee growth and coverage of the sod planted under this contract to the effect that a minimum of 95% of the area planted will be covered with the specified planting after 60 days. Sod panels that are dead or dying shall be replaced.

B. The Contractor shall be responsible for one mowing, in the event that the time between sodding and final acceptance exceeds thirty days.

C. The Contractor shall make a second planting to those bare areas not meeting specified planting as determined by the Engineer. Such replanting is to be performed within 90 days of initial application and upon notification by the Engineer to replant.

END OF SECTION 32 92 23.16

SECTION 33 01 30.13 - SANITARY SEWER TCEQ MANHOLE REQUIREMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

A. This section provides for those TEXAS WATER CODE AMENDMENTS as published in the Texas Register with an ***Effective date of September 1, 2008.*** These requirements are binding for all Sanitary Sewer Manholes.

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 SYSTEM DESCRIPTIONS

A. Design Requirements:
   1. Manholes shall be placed at all points of change in alignment, grade or size of sewer, at the intersection of all sewers and the end of all sewer lines that will be extended at a future date. Any proposal which deviates from this requirement shall be justified to the satisfaction of the TCEQ Executive Director. Clean-outs with watertight plugs may be installed in lieu of manholes at the end of sewers which are not anticipated to be extended. Such installations must pass a leakage test and a deflection test for all flexible lines.

1.4 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manholes shall be monolithic, cast-in-place concrete, fiberglass, precast concrete, HDPE or of equivalent construction as shown on the Plans. Brick manholes shall not be used, nor shall brick be used to adjust manhole covers to grade.

PART 3 - EXECUTION

3.1 CONSTRUCTION DETAILS

A. The maximum required manhole spacing for sewers with straight alignment and uniform grades are in the following table. Reduced manhole spacing may be necessary depending on the utility's ability to maintain its sewer lines. Areas subject to flooding require special consideration to minimize inflow.

Pipe Diameter (inches)	Maximum Manhole Spacing (feet)
6 - 15	500

18 - 30	800
36 - 48	1000
54 or larger	2000

B. Watertight, size-on-size resilient connectors allowing for differential settlement shall be used to connect pipe to manholes. Pipe to manhole connectors shall conform to ASTM C-923. Other types of connectors may be used when approved by the TCEQ. Manholes should not allow surface water to drain into them. If manholes are located within the 100-year flood plain, the manhole covers shall have gaskets and be bolted or have another means of preventing inflow. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1500 foot intervals. Vents should be designed to minimize inflow. Impervious material should be utilized for manhole construction in these areas in order to minimize infiltration.

C. Diameter
1. Manholes shall be sufficient inside diameter to allow personnel to work within them and to allow proper joining of the sewer pipes in the manhole wall. The inside diameter of manholes shall be not less than 48 inches.

D. Inverts
1. The bottom of the manhole shall be provided with a "U" shaped channel that is as much as possible a smooth continuation of the inlet and outlet pipes. For manholes connected to pipes less than 15 inches in diameter the channel depth shall be at least half the largest pipe diameter. For manholes connected to pipes 15 to 24 inches in diameter the channel depth shall be at least three fourths the largest pipe diameter. For manholes connected to pipes greater than 24 inches in diameter the channel depth shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5 inches per foot. Where sewer lines enter the manhole higher than 24 inches above the manhole invert, the invert shall be filleted to prevent solids deposition. A drop pipe should be provided for a sewer entering a manhole more than 30 inches above the invert.

E. Covers
1. Manhole covers of nominal 30-inch or larger diameter are to be used for all sewer manholes.

F. Access
1. Design of features for entering manholes shall be guided by the following criteria.
   a. It is suggested that entrance into manholes in excess of four feet deep be accomplished by means of a portable ladder. Other designs for ingress and egress should be given careful evaluation considering the safety hazards associated with the use of manhole steps under certain conditions.
   b. Where steps are used, they shall be made of a non-corrosive material and be in accordance with applicable OSHA specifications as published by the United States Department of Labor.

3.2 TESTING

A. Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other methods acceptable to the Commission. If a manhole fails a leakage test, the manhole must be made watertight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the

manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete.

B. Procedure for Vacuum Testing
1. Vacuum test according to ASTM C 1244, latest edition.
2. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
3. A vacuum of 10 in. of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop from 10 in. to 9 in. of mercury.
4. The manhole shall be considered as passing if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 1.
5. If the manhole fails the initial test, necessary repairs shall be made by a method approved by The Engineer. The manhole shall then be retested until a passing test is obtained.
6. Use or failure of this vacuum test shall not preclude acceptance of the manhole by appropriate water exfiltration testing, or other preapproved means and methods.

TABLE 1 - MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS

Depth (Feet)	Diameter (in.)								
	30	33	36	42	48	54	60	66	72
	Time (sec.)								
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	45	51	57
16	22	24	30	34	40	45	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

END OF SECTION 33 01 30.13

SECTION 33 11 00 - WATER DISTRIBUTION SYSTEM (PVC)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

A. These specifications shall govern the furnishing and placing of water distribution lines, fittings, valves, fire hydrants, and other appurtenances. The pipe and accessories shall be installed in accordance with the requirements of these specifications at the locations and depths indicated on the plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints, connections to new or existing pipes, and installation of all fittings, valves, fire hydrants, and appurtenances.

1.2 GENERAL

A. Piping for water mains shall be of the type and materials specified herein, at the Contractor's option, unless otherwise indicated on the drawings or in this section. The pipe and accessories shall be new and unused. The interior of the pipe shall be thoroughly cleaned of foreign matters before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Any pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water, or when trench or weather are unsuitable for the work. Water shall be kept out of the trench until the jointing is complete. When work is not in progress, open ends or pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe without additional expense to the Owner.

1.3 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.4 WATER LINE - SANITARY SEWER LINE CROSSINGS

A. The water pipe shall not be laid closer horizontally than 9 feet in all directions and parallel lines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following shall apply. The sewer line need not be disturbed where the water line shall be installed parallel to an existing sewer line that shows no evidence of leakage and the water line is installed above the sewer line a minimum of two feet vertically and four feet horizontally. Should excavation for the water line produce evidence that the sewer is leaking, the sewer line shall be replaced as described in SECTION 33 33 13 - SANITARY SEWER LINES. The sewer line shall not be disturbed where a new water line is to cross over (by two feet or more) existing sewer lines showing no evidence of leakage.

1.5 METHOD OF MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All pipe shall be new and made in the United States. All plastic pipe must also bear the National Sanitation Foundation Seal of Approval (NSF-PW) and have an ASTM design pressure rating of at least 150 psi or a standard dimension ratio of 26 or less. Water Distribution Lines must be installed in accordance with the manufacturer's instructions. All water Line materials and appurtenances shall comply with Section 290.44(b) of the Texas Natural Resource Conservation Commission Rules and Regulations for Public Water Systems regarding lead banned from piping and joints.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

A. Requirements for unplasticized polyvinyl chloride (PVC) pipe with bell joints which are integral to the pipe and are well thickened so that standard dimension ratios are maintained or exceeded.

B. Plastic pipe in 4" and larger sizes shall conform to all requirements of AWWA C900 - DR 18, Class 150.

C. Plastic pipe in 2", 2 1/2" and 3" sizes shall conform to all requirements of ASTM D 2241 for PVC pipe and be pressure rated at 200 psi with a standard dimension ratio (SDR) of 21 for Class 200 for both barrel and bell dimensions.

D. Plastic pipe in sizes smaller than 2" shall conform to all requirements of Schedule 40 and have Schedule 80 fittings.

2.3 COPPER TUBING

A. All 3/4", 1", 1-1/2" and 2" copper tubes for underground service shall Be Type "K" soft annealed with the proper bending temper. All 3/4" And 1" tubes shall be furnished in coils, each containing 60 feet; FLAT coils are preferred. Other diameters of tubes shall be furnished in straight lengths of 20 feet.

2.4 BRASS FITTINGS

A. All brass fittings shall conform to ASTM Specifications B-62- 52 And shall be those manufactured by the Mueller Company or preapproved equivalent.

2.5 FITTINGS

A. All fittings shall be cast iron or ductile iron and shall conform to the latest edition of AWWA Specifications.

B. All ductile iron fittings shall be coated outside with a bituminous coating of either coal tar or asphalt. The inside coating shall be a cement-mortar lining in accordance with AWWA Specification.

C. All fittings shall be new and made in the United States.

D. All ductile iron fittings shall be approved by Underwriters Laboratories and shall be accepted by the State Fire Insurance Commission for use in city water distribution systems without penalty.

E. Rubber gaskets for these fittings shall be manufactured in accordance with AWWA specifications.

2.6 GATE VALVES

A. All gate valves shall be designed for a cold hydrostatic working pressure of 175 pounds per square inch for valves with diameters of 3-12 inches, inclusive with shop test of 300 pounds per square inch and a working pressure of 150 pounds per square inch for valves with diameters of 16-48 inches, inclusive with shop test to 300 pounds per square inch. All gate valves shall conform to the requirements of AWWA C500-86 Specification. Valves will be equipped with O-ring stem seals.

B. Gate valves shall be iron body, *resilient seated*, non-rising stem conforming to the requirements of AWWA C509-87 and shall open counter-clockwise. Tapping valves shall be flanged to fit a tapping sleeve on one side and shall be mechanical joint on the other side, with provisions for attaching a standard tapping machine. Gate Valves, fourteen (14) inches and smaller, shall be designed for vertical installation; gate valves, sixteen (16) inches and larger, shall be designed for operation with the stem horizontal or vertical as shown on the plans. Horizontal valves shall be provided with enclosed lubricated bevel gears, bronze gate roller and tracks, bypass valve, and two (2) inch operating nuts on main and bypass valves. Vertically mounted valves sixteen (16) inches and larger shall be designed for operation with the stem vertical and shall be provided with enclosed lubricated spur gears, bypass valve and two (2) inch operating nuts on main and bypass valves. Valves in two (2) inch cast iron screw joint pipe may be two and one-half (2-1/2) inches brass, non-rising stem, wedge disc with thread hubs. Gate valves shall be Mueller, Stockham, M & H or a preapproved equivalent.

C. Unless otherwise specified, all gate valves shall be installed complete with valve box.

2.7 FIRE HYDRANTS

A. Fire hydrants shall be Mueller Super Centurion or an approved equivalent.

B. Each hydrant shall be factory tested to a hydrostatic pressure of 300 psi with valve in both the open and closed positions. The direction of opening nut shall be counterclockwise and shall be cast on the head of the hydrant. Hose nozzles shall be bronze or non-corrosive metal and threads shall be national standard. The main valve opening shall be either five and one-fourth (5-1/4) inches in diameter or six and one-fourth caps shall be provided with gaskets. Bury length shall be three and one-half (3-1/2) feet unless otherwise noted on the plans. Hydrants shall be provided with "dry top" which prevents stem threads from contacting water, and "break-off" type barrel and stem.

C. Hydrants shall be painted with shop coating in accordance with AWWA C502 specification. Final coats of paint will be applied by Contractor in accordance with fire department requirements.

D. Contractor shall verify and make nozzle threads consistent with local fire department.

2.8 AIR VALVES

A. Air valves shall be of the type indicated on the plans. The assembly shall not leak nor shall the valve stick under service conditions.

2.9 CORPORATION COCKS

A. Corporation cocks shall be of the size specified on the plans. Inlet threads shall be Mueller thread or approved equal. Outlet threads shall be one size larger than listed cock size. Corporation cocks shall be Mueller, H-15000 or a preapproved equivalent.

2.10 VALVE BOXES

A. Valve boxes shall be cast iron, adjustable height with cover marked "water". Valve boxes shall be

Alamo Iron Works #813-30 or a preapproved equivalent.

2.11 WATER METERS

A. Water meters shall conform to the requirements of AWWA C700, latest revision and shall be of the displacement type. Case shall be bronze, and the register shall be sealed. Accuracy shall be at least 100% plus or minus 1.5% of actual through put. Maximum operating pressure shall be 150 psi. Unless noted otherwise, meters shall be as manufactured by Sensus Technologies, Inc. or a preapproved equivalent.

B. Boxes for water meters shall be of a key-lock type.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Unless otherwise specified, the provisions of this section shall conform to AWWA C600-64 specifications.

3.2 LAYING AND JOINTING

A. Pipe, fittings, valves, and hydrants shall be carefully handled to avoid damage. While they are suspended over the trench, before lowering, they shall be inspected for defects and rung with a light hammer to detect cracks. To ensure proper seating for the spigot and against the shoulders of the bell, each joint shall be lightly swung against the last joint laid before unhooking the sling. Joints of small diameter pipe, installed by hand, shall be properly seated by using an iron bar or other suitable lever to force the spigot end against the shoulders of the bell of the last previously laid joint. Before any pipe is laid, all dirt shall be removed from the inside, and all lumps, blisters, excess tar coat, dirt, oil, grease, and moisture shall be removed from inside the bell and from outside the spigot end. All pipe shall be laid and maintained to the lines and grades shown on the plans or as established on the ground by the Engineer. Wherever it is necessary to deflect pipe from a straight line, the degree of deflection at each joint shall not exceed the maximum deflection recommended by the manufacturers of the pipe being laid. Bell ends shall face the direction of laying. After pipe is laid, care shall be taken to avoid the entrance of dirt, water or other substances by the use of tight bulkheads or plugs.

B. Gasket material shall be kept in clean containers and shall not be allowed to come in contact with the ground. Gasket material which has become contaminated or dirty shall be destroyed.

C. Mechanical joints shall be installed in accordance with the manufacturer's recommendations.

D. Unless otherwise shown, valves shall be located on the extension of street property line. Every valve, including bypass valves, shall be provided with a valve box. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the cover flush with the pavement surface or such other level as directed.

E. Hydrants shall be located as shown on the Plans and in a manner that will provide complete accessibility and will prevent damage from vehicles. All hydrants shall stand plumb and shall have their pumper connections at right angles to the street. When placed immediately behind the curb, the hydrant barrel shall be set so that no portion of the steamer or hose connection cap will be less than six (6) inches from the gutter face of the curb.

F. Minimum cover on water lines shall be forty-eight (48) inches unless otherwise specified, but in no case shall the top of any water line be less than 24 inches below the finished ground surface.

3.3 EXCAVATION

A. All excavations are to be by the open-trench method, unless the Engineer orders that certain sections of the mains are to be laid in tunnels or bored.

B. The minimum width of the bottom of the trench shall be such that there will be six inches space on each side between the pipe and the walls of the trench. The width of the trench at the surface is not to be less than at the bottom.

C. When excavating machinery is being used, the same shall cut the trench to a grade slightly higher than the bury indicated by the proposal and the trench shall then be fine graded.

D. The trench must always be opened and excavated to the finished grade for a distance of at least 50 feet in advance of the last made-up joint. Water mains into which the mains under construction are to be connected must be located well in advance of such connection to allow for possible adjustment of alignment and/or grade.

E. Bell holes must be excavated in advance of placing the pipe. Materials used shall be placed at locations so as not to interfere unnecessarily with the use of the streets by the public, and not more than two streets intersections shall be closed at any time. The street surface along the line of the trench must be kept free of surplus spoil.

F. The expense of restoring the original condition of improved property in connection with grass, shrubs or any other improvements must be borne by the Contractor. All trees adjacent to the trench must be protected and the trees on public or private property must not be cut unless permission, in writing, is granted.

3.4 BEDDING

A. Sand bedding shall be as shown on the Plans with a minimum compacted depth of six inches.

3.5 ROCK EXCAVATION

A. No rock is anticipated, and no extra compensation will be allowed for rock excavation.

3.6 JACKING, BORING & TUNNELING

A. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.

B. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.

C. Jacking: If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.

D. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

E. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.

F. The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support of back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

G. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

H. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.

I. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.

J. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.

K. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

L. Boring: The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.

M. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.

N. In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the

walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter.

O. Allowable variation from line and grade shall be as specified under "Jacking". Overcutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.

P. Tunneling: Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.

Q. The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".

R. The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.

S. The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.

T. Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.

U. If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.

V. Clean-up: Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.

W. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.

3.7 CROSSING STATE HIGHWAYS AND RAILROADS

A. When water lines cross highways, railroads, or town streets under the jurisdiction of the TxDOT or other public body or corporation, the Contractor shall secure permission from the controlling authority before installing such lines.

3.8 WET CONNECTIONS

A. Wet connections are defined as connections made to a line in the existing system by interrupting water service. They shall be made at such points as are shown on the plans or as designated by the Engineer. The method and the equipment to be used shall be submitted to the Engineer for approval before any work is done.

B. Any time that the interruption of water service in the existing system is necessary because of operations under this contract, the Contractor shall notify the City Water Superintendent forty-eight (48) hours in advance. The Contractor will not operate any valve in the existing water system.

3.9 LOWERING OF EXISTING MAINS

A. When a main is to be lowered in order to conform with new construction, the initial excavation shall be done in such a manner as to permit the mains to rest on several dirt benches, or wooden blocks

if soil conditions are unsatisfactory for the benches. The pipe shall then be supported by ropes, cables or chains to overhead supports; the dirt benches or wooden block removed, and the pipe slowly and evenly lowered into position. After the mains have been lowered, each damaged joint must be re-tightened as directed by the Engineer.

3.10 REMOVING PIPE

A. Salvageable joint materials from each joint of the pipe must be removed and reclaimed for the Owner and all corporation cocks disconnected and the holes plugged with plugs furnished by the Owner before the pipe is raised from its original position. After raising the pipe from the trench, it shall be pulled apart at the joints and all foreign material removed from the bells and spigots.

B. All removed materials are to remain the property of the Owner and shall be hauled to the Owner's storage yard.

C. The unit bid prices for removing mains shall include the removal, the cleaning of exterior and connection surface and hauling to designated storage yards, of all fittings, valves, flushing valves, and other appurtenances.

3.11 TRENCH BACKFILL

A. All trench backfill above pipe embedment shall conform to the following requirements:

B. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road, or highway shoulders.

C. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the pipe, then the balance of the backfill shall be placed in twelve inch (12") layers with Compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.

3.12 SURPLUS EARTH

A. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use for this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

3.13 STREET SURFACES

A. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to making the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, except as otherwise provided herein.

B. All concrete paving, road gravel, and road shell ordered placed on streets will be paid for at the unit price bid.

C. On gravel, shell and asphalt surfaced streets, the trench shall be filled as otherwise specified up to within eight inches of the surface of the street. The trench shall then be filled with gravel or shell, as ordered by the Engineer, to a point approximately one (1) inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or shell as is ordered by the Engineer. No extra payment for road

gravel or stabilized shell.

D. On concrete streets the trenches shall be filled as otherwise specified within six (6) inches of the surface of the street, and then filled with road gravel or shell to a point approximately one (1) inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient shell and install six (6) inches of concrete as ordered by the Engineer. The concrete used shall be paid for at the unit price bid in the proposal schedules.

E. On asphalt surfaced streets, the gravel or shell base shall be placed as stated above. At such time as directed by the Engineer, the gravel or shell base shall be leveled smooth approximately one (1) inch below the existing asphalt surface. The new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

3.14 CROSSINGS TO BE KEPT OPEN

A. At such street crossings and other intermediate points as may be designated by the Engineer, the trenches shall be bridged in such proper and secure manner as to prevent any serious interruption of travel upon the roadway and sidewalks, the cost thereof to be borne by the Contractor.

B. Clean Up: Contractors equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.

C. Laying Pipe: In general, the bottom of the trench shall be shaped to give full support to the lower quarter of each pipe. If the foundation is rock or other hard material, a bed of sand or suitable earth shall be placed upon the subgrade and well compacted. The thickness of the bed shall be not less than two (2) inches nor more than six (6) inches. If the foundation is of such material or if conditions are such that the pipe cannot be otherwise properly supported or if the load on the pipe so requires, a concrete cradle as hereinafter specified shall be provided. In all cases water shall be kept out of the trench until the masonry or jointing material has sufficiently hardened. The pipe shall be laid to grade shown on the plans or as directed by the Engineer. Each pipe shall be inspected for defects prior to being lowered into the trench and shall be carefully cleaned in both bell and spigot. Pipe laying shall proceed up-grade with spigot ends pointing in direction of flow. Pipes shall be laid so that each pipe shall rest upon the full length of its barrel with holes excavated to accommodate bells. Except by special permission, no pipe shall be laid except in the presence of an inspector. Any defective pipe laid or any pipe which has had its grade of joint disturbed after laying shall be taken up and replaced.

D. Before joining the inside of the bells and outside of the spigots shall be dry and clean. The joint shall be made as recommended by the manufacturer of the joint material. Water shall not be allowed in the trenches while the pipes are being laid. The Contractor shall not open up more trenches than the available pumping facilities are able to de-water, to the satisfaction of the Engineer. Bells shall be entirely free of water when joints are made, regardless of the type of joint, and no water shall be allowed to rise over the joint until it has set.

3.15 HOUSE CONNECTIONS

A. House connections to main pipe shall be made by tapping the main and installed corporation cock of the size designated. The corporation cock shall be screwed securely into position. The copper service, polyethylene or butylene pipe shall be connected to the corporation cock and laid in accordance with the specifications contained herein for laying pipe.

3.16 INSTALLING WATER METERS AND METER BOXES

A. Water Meters: The ground shall be excavated to such depth that the top of the box is flush with

normal ground level. The tail piece of the meter shall be inserted into the service lines as near to the curb cock as possible, or directly into the curb cock. The meter shall then be set in such position that the bottom of the meter is at least two (2) inches above ground. The house side of the meter shall then be connected to the service line running to the house. It is essential that the meters shall be set plumb and in line with the service line and all connections made in a neat and workmanlike manner.

B. Meter Boxes: The meter box shall be set on firm ground so that the top of the meter box is flush with the ground surface, and the box is level and plumb. Ground shall be carefully backfield and tamped around the meter box to leave a neat appearance.

3.17 SETTING FIRE HYDRANTS

A. Fire hydrants shall be set where shown on the plans or ordered by the Engineer.

B. Excavate underneath the drain outlet of each fire hydrant a space twelve (12) inches square and six (6) inches deep and fill with gravel. Place the gravel up around bottom of the flushing hydrant not less than three (3) inches above the drain outlet. Not less than two (2) cubic feet of gravel shall be placed around each flushing hydrant. The gravel shall be carefully covered with a layer of one ply roofing paper before trench around the hydrant is refilled. All hydrants shall be carefully blocked and placed to prevent expansion of stub line from water pressure. See plan sheet for blocking details.

3.18 STERILIZATION OF PIPELINES

A. Unless otherwise specified, sterilization of new water lines shall be done in accordance with AWWA C651-86 specification.

B. The contractor shall furnish all labor equipment, and materials necessary for the sterilization of the new pipelines, which shall be sterilized before being tested and placed in service. The lines shall be sterilized by the application of a chlorinating agent. The chlorinating agent may be liquid chlorine, liquid chlorine gas-water mixture, or a calcium hypochlorite solution, which shall be fed into the lines through a suitable solution-feed device or other methods approved by Engineer. The chlorinating agent shall be applied at or near the point from which the line is being filled, and through a corporation stop or other approved connection inserted in the horizontal axis of the newly laid pipe. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly, and the rate of water entering the pipe that the chlorine dose applied to the water entering the line shall be a minimum of 50 ppm of chlorine residual of not less than twenty five (25) ppm after twenty-four (24) hours standing in the pipe. At the end of the retention period, all treated water shall be thoroughly flushed from the lines until the replacement water in the lines shall have a chlorine residual of not more than 0.4 parts per million.

C. Solvent cemented or welded joint pipes shall be sterilized using a sterilizing agent other than liquid chlorine and/or calcium hydrochloride.

D. Where no suitable outlet is available for flushing dead ends, the Contractor shall furnish and install outlet valves of sufficient size to adequately flush the new mains at the locations designated by the Engineer, for which payment shall be made at the unit price bid for the size valve installed. After the lines are sterilized and flushed and tested as specified above, samples of water shall be taken from the mains for bacteriological tests. If the samples fail to meet the health departments standard requirements, the disinfection process as outlined above shall be repeated and continued until the tests show results that meet the health departments requirements.

3.19 HYDROSTATIC TEST

A. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.

B. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.

C. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.
   1. L = SD((P)^(1/2))/133,200, where L = leakage in gal/hr
   2. S = length of pipe in feet
   3. D = inside diameter of pipe in inches
   4. P = pressure in pounds per square inch

D. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.

E. Upon completion of all sterilization and testing, the Contractor shall provide personnel to open all valves and operate all hydrants, as directed, in the presence of a representative of the Engineer.

END OF SECTION 33 11 00

SECTION 33 33 13 - SANITARY SEWER LINES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

A. Work under this Section includes furnishing all plant, labor, materials, equipment, tools, incidentals and the performance of all work necessary to complete all sanitary sewers and appurtenances, as shown on the drawings and herein specified including the following:
   1. Sanitary Sewers
   2. Sanitary Sewer Manholes and Cleanouts
   3. Service Connections
   4. Force Main

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 METHOD OF PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sanitary sewer pipe shall be one or any of the following materials or any combination as required by the Plans.
   1. PVC
      a. Polyvinyl Chloride (PVC) Pipe for Pressure Rated Lines shall be of the best quality, push-on type, with factory pre-molded gasketed joints. Pipe shall conform to ASTM D-2241 for PVC pipe.
      b. PVC pipe for gravity sewer should be of the best quality, bell and spigot, with factory pre-molded gasketed joints. Pipe shall conform to ASTM D-3034, SDR 26, for PVC pipe, unless otherwise noted on the plans. All PVC pipe shall be manufactured from Cell Class 12454B in accordance with ASTM D-1784.

   2. Ductile Iron Pipe
      a. Ductile Iron Pipe shall be designed in accordance with ANSI Standard A21.50 (AWWA C-151), or the latest revision thereof. Ductile iron pipe shall be thickness Class 50, pressure rated for 150 PSI unless otherwise indicated on the plans or in the Special Provisions of the Specifications. Pipe and fittings shall be lined with 20 mils of epoxy. Extend lining from plain or beveled end to rear of gasket socket.
      b. The exterior of the pipe shall have a bituminous coating approximately one mil in thickness.
      c. Polyethylene encasement for use on ductile iron pipe and fittings shall be eight (8) mils thick and conform to the latest revision of ANSI Specification A21.5 (AWWA

C-105). All pipe, fittings and appurtenances shall be Polyethylene encased.

d. Polyethylene encasement shall be installed in accordance with the latest revision of ANSI 21.5 (AWWA C-105) standard and shall prevent contact between the buried pipe and appurtenances and the surrounding backfill and bedding material but is not intended to be a completely air and watertight enclosure. Overlaps shall be secured by use of adhesive polyethylene tape, plastic string, binder twine or any other material capable of holding the encasement in place until the backfilling operations are completed.

e. Pipe shall be encased in polyethylene tubes with sheets being used in irregular shapes if the tube is not adaptable.

3. Centrifugally Cast Fiber Glass Pipe

a. Centrifugally Cast Fiber Glass Pipe, joints and fittings supplied under this specification shall, as a minimum, conform to the requirements of AWWA C950-81, AWWA Standard for Glass-Fiber Reinforced Thermosetting-Resin Pressure Pipe and ASTM D3517, Standard Specification for Reinforced Plastic Mortar Pressure Pipe, in the case of pressure pipes, and ASTM D3262, Standard Specification for Reinforced Plastic Mortar Sewer Pipe, in the case of gravity sewer pipes. Prior to manufacturing, the pipe supplier shall provide the Engineer with independent laboratory test reports certifying that the pipe has been tested in accordance with and exceeds all minimum requirements of ASTM D-2992 and ASTM D-3681. Manufacturer's "in house" test reports will not be acceptable as a substitute for independent laboratory testing.

b. The Manufacturer shall use only approved polyester resin systems for which he can provide a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.

c. The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade of glass filaments with binder and sizing compatible with impregnating resins.

d. Silica sand or other suitable materials may be used.

e. Resin additives, such as pigments, dyes, and other coloring agents, if used, shall in no way be detrimental to the performance of the product nor shall they impair visual inspection of the finished product.

B. Joints

1. PVC

a. PVC Pipe bell and spigot joints shall be factory pre-molded, compression type joints of elastomeric material.

b. The integral bell gasketed joint shall be designed so that when assembled, the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendation. The joints shall conform to ASTM D-3212 specification standards.

c. All gaskets shall be molded into a circular form and extruded to the proper section and then sliced into circular form and shall consist of a properly vulcanized high-grade elastomeric compound.

d. The basic polymer shall be natural rubber, synthetic elastomer or a blend of both, and meeting the physical requirements prescribed within this specification. The gasket shall provide an adequate compressive force so as to affect a positive seal under all combinations of joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. The gaskets shall conform to ASTM F-477 specification standards.

2. Ductile Iron Pipe
   a. Ductile Iron Pipe and Fittings Push-on joints shall conform to ANSI Standard A21.11, Section 11-2.3 (AWWA C-111 Section 11-2.3) the latest revision thereof. All required lubricant shall be included with the pipe and/or fittings. These joints shall be used for underground installation of the sewer.
   b. Mechanical joints shall conform to ANSI Standards A21.10 and A21.11 latest revision. All required lubricant shall be included. These joints shall be used for underground installation. Bolts underground shall be cadmium plated.
   c. Flanged joints for pipe shall conform to ANSI Standard A21.15 (AWWA C-115) the latest revision thereof. Flanges shall be class 125 drilled and faced in accordance with ANSI Standard B16.1. Required nuts, bolts and gaskets are to be included with Pipe and/or fittings. These joints shall be used inside structures and above ground installation.
   d. Flanged joints that are fabricated by someone other than the pipe manufacturer shall be made from Class 53 pipe to ensure that the wall thickness in the threaded area is not less than that of Class 50 pipe. The OWNER or his authorized representative shall have the right to make periodic inspections of the fabricators shop.

3. Centrifugally Cast Fiber Glass Pipe
   a. Centrifugally Cast Fiber Glass Pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing rings as the sole means to maintain joint water-tightness. The joints must meet the performance requirements of ASTM D4161.
   b. Flanges, elbows, reducers, tees, wyes, and other fittings shall, when installed, be capable of withstanding all operating conditions. They may be contact molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays. For design pressures of over 150 psi, Type 316 stainless steel fittings or fusion epoxy-coated steel fittings shall be provided.

C. Manholes
1. All manholes shall be constructed, complete with covers, in accordance with the details shown on the Drawings. Manholes shall be constructed of solid precast curved segmental concrete units, circular sections specially cast for use in manhole construction, or of fiberglass reinforced plastic in accordance with the Plans and as approved by the Engineer.
2. Manholes shall be constructed of materials which shall conform to the following:
   a. Concrete: As specified in the concrete specification.
   b. Segmental Concrete: ASTM C 139, except as modified herein.
   c. Circular Precast Sections: ASTM C 478
   d. Castings:
      1) Iron: ASTM A 48
      2) Coating: Hot Asphaltum varnish applied at the foundry.
   e. Fiberglass: Heavy wall, Owens-Corning Fiberglas or L.F. Manufacturing, Inc. Provide "O" ring for all pipe connections. The concrete base for a standard 48-inch diameter fiberglass manhole shall be a minimum of 6'x 6'x 15" thick with #5 bars at 12" on center each way. Backfill with bank sand or approved equivalent in 12" maximum lifts. Compact each lift to 95% standard proctor density.
   f. All manholes shall have stainless steel manhole inserts (inflow preventers) installed under the manhole covers to prevent infiltration.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

A. Laying Pipe

1. Pipe shall be protected from lateral displacement by means of pipe embedment material installed as provided in the trench backfill specification. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.
2. When jointed in the trench, the pipe shall form a true and smooth line. Pipe shall not be trimmed except for closures, and pipe not making a good fit shall be removed. Permissible defects shall be placed in the top of the pipe.
3. Unless otherwise approved by the Engineer, the laying of pipe shall be begun at the lowest point and the pipe shall be installed so that the spigot ends point in the direction of flow.
4. The installation of all pipes and fittings shall meet the requirements of the manufacturer's published installation instructions. The Manufacturer must supply a suitable qualified field service representative to be present periodically during the installation of the pipes.
5. Alignment and Grade
   a. Unless otherwise shown on the plans, all pipe shall be laid straight between changes in alignment and at a uniform grade between changes in grade. All lines shall be laid so that each section between manholes will lamp.
   b. The Contractor shall erect substantial batter boards at intervals of not more than 50 feet. Batter boards or approved laser light shall be used to determine and check pipe subgrades. Not less than three batter boards shall always be maintained in proper position when trench grading is in progress.

B. Trench Construction

1. All excavated material should be stockpiled in a manner that will not endanger the work. Hydrants under pressure, water and gas valves, manhole covers, fire and police call boxes, or other utility controls should be left unobstructed and accessible until work is completed. Gutters should be kept open, or other satisfactory provisions should be made for street drainage. Natural water courses should not be obstructed. Unless otherwise approved, stockpiles should not obstruct adjacent streets, walks, or driveways.
2. The maximum earth load on flexible pipe (PVC pipe) results from the consolidated prism of earth directly over the width of the pipe. If design load on the pipe is calculated based on embankment conditions (prism), the trench may be excavated to a width which is as wide as is dictated by practical and economical construction.

   Types of construction for various anticipated conditions are described as follows:
   a. **Narrow Unsupported, Vertical-Walled Trench**: The amount of pavement to be removed and replaced and amount of embedment material used may dictate that the most economical installation is the narrow, vertical-walled trench. The width of narrow trenches as determined by the minimum working room for a man to place haunching material should provide a minimum of 18 inches for 4" and 6" size pipes and not more than 6 to 9 inches clearance on each side of the pipe for 8" and larger sizes. In narrow trenches the pipe embedment should be compacted all the way to the trench walls.

NARROW TRENCH WIDTH, MINIMUM

Nominal Pipe Size Inches	No. of Pipe Diameters (O.D.)	Trench Width Minimum
4	4.3	18
6	2.9	18
8	2.9	24
10	2.5	26
12	2.4	30
15	2.0	30

b. **Unsupported Sub-Ditch Trench**: A Variation of the narrow vertical-walled trench is to lay the pipe in a sub-ditch and back cut or slope the sides of the excavation above the top of the pipe. This type of construction may be permitted where no inconvenience to the public or damage to property, buildings, subsurface structures, or pavements will result. In such case, the width of the sub-ditch below the top of pipe should be established as shown in "NARROW TRENCH WIDTH" Table.

c. **Wide Trench**: Wide trenches are classified as trenches whose width at the top of the pipe is greater than 2-1/2 pipe diameters on each side of the pipe or a total of 6 pipe diameters. There is no limit to the maximum width of the trench beyond 2-1/2 pipe diameters from the side of the pipe since the maximum earth load on flexible pipe does not exceed the weight of the earth prism directly over the pipe. However, the pipe embedment in wide trenches should be compacted to a point at least 2-1/2 pipe diameters from each side of the pipe.

d. **Supported Trench**: Where an unstable or flowing soil condition is encountered in the trench wall, such as may be found by excavation below ground water or in weak or non-cohesive soils, this condition must be stabilized before laying the pipe. Depending upon the severity of the condition, jacks, a trench shield or box to support the trench during pipe laying operations may be necessary . If the condition is too severe, it may be necessary to leave any sheeting in place or to use chemical or cement grouting of the soil adjacent to the excavation to prevent migration between the material used beneath and around the pipe and trench wall material.

SUPPORTED TRENCH WIDTH, MINIMUM

Nominal Pipe Size (Inches)	No. of Pipe Diameters (O.D.)	Trench Widths, Minimum (Inches)
4	8.5	36
6	5.7	36
8	4.3	36
10	4.0	42
12	3.4	42
15	3.1	48

e. Widths are based upon 8 to 10 inches clearance on each side of the pipe to the inner face of trench supports. The trench supports are assumed to be 6-inch-thick trench box or shield walls of 4-inch wales inside of 2-inch sheeting. Exceptionally deep trenches with thicker sheeting and bracing or other systems of trench support may require variations of these trench widths. Timber sheeting, where used below the top of the pipe, should be driven approximately 2 feet below the bottom of the pipe and be left in place approximately 1.5 feet above the top of pipe. In supported trenches, compaction of foundation and embedment materials should extend to the trench wall or sheeting left in place.

f. **Movable Sheeting, Trench Boxes or Shields**: When using movable trench support, care should be exercised not to disturb the pipe location, jointing or its embedment. Removal of any trench protection below the top or the pipe and within 2-1/2 pipe diameters of each side of the pipe should be prohibited after the pipe embedment has been compacted. For this reason, movable trench supports should only be used in either wide trench construction where supports extend below the top of the pipe or on a shelf above the pipe with the pipe installed in a narrow, vertical-wall sub-ditch. Any voids left in the embedment material by support removal should be carefully filled with granular material which is

adequately compacted. Removal of bracing between sheeting should only be done where backfilling proceeds and bracing is removed in a manner that does not relax trench support. When advancing trench boxes or shield, prevent longitudinal pipe movement or disjointing.

3. Dewatering
   a. Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water should be removed by pumps and suitable means such as well points or pervious underdrain bedding until the pipe has been installed and the backfill has been placed to a sufficient height to prevent pipe flotation. Care should be taken that any underdrain is of proper gradation and thickness to prevent migration of material between the underdrain, pipe embedment and native soils in the trench below and at the sides of the pipe.

4. Preparation of Trench Bottom
   a. The trench bottom shall be excavated below grade to provide the specified depth of bedding and support for the full length of the pipe. Any part of the trench bottom excavated below grade should be backfilled to grade and should be compacted as required to provide firm pipe support. When an unstable subgrade condition is encountered which will provide inadequate pipe support, additional trench depth should be excavated and refilled with suitable foundation material. In severe conditions special foundations may be required such as wood pile or sheeting capped by a concrete mat, wood sheeting with keyed-in plank foundation, or foundation material processed with cement or chemical. A cushion of acceptable bedding material should always be provided between any special foundation and the pipe. Ledge rock, boulders, and large stone should be removed to provide four inches of soil cushion on all sides of the pipe and accessories.

5. Laying of Pipe
   a. Proper implements, tools, and equipment should be used for placement of the pipe in the trench to prevent damage. Under no circumstances should the pipe or accessories be dropped into the trench.
   b. Pipe bells should be laid on the upstream end. Pipe laying should commence at the lowest elevation and should terminate only at manholes, service branches or clean-outs. All foreign matter or dirt should be removed from the pipe interior. Pipe joints should be assembled with care. Whenever pipe laying is interrupted, the open ends of installed pipe should be closed to prevent entrance of trench water, mud, or foreign matter.

C. Branch Fittings
   1. Fittings for service branches in new construction should be molded or fabricated with all gasketed connections. Taps into existing lines should use a gasketed fitting in conjunction with a repair sleeve coupling or a gasketed saddle wye or tee with all stainless-steel clamps. Saddles may be mounted on pipe with solvent cement or gasket but should be secured by metal banding. Saddles should be installed in accordance with manufacturer's recommendations. Holes for saddle connections should be made by mechanical hole cutters or by keyhole saw or sabre saw. Holes for wye saddles should be laid out with a template and should be de-burred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting. Fittings which are prefabricated using pipe sections, molded saddles and PVC solvent cement may be used, provided the solvent cement used in fabrication has cured at least 24 hours prior to installation. Cemented mitered connections without socket reinforcement should not be used. PVC Primer and solvent cement should be used in accordance with the cement manufacturer's recommendations and ASTM D2855, Making Solvent-Cemented Joints with PVC Pipe and

Fittings. After solvent cementing saddles, temporary band clamps should be quickly placed both upstream and downstream of the saddle and tightened.

D. Service Lines
1. Service Lines from the property line to the collection sewer should be at a minimum depth of 3 feet at the property line and should be laid to straight alignment and uniform slope of not less than 1/4 inch per foot for 4-inch pipe and 1/8 inch per foot for 6-inch pipe. Where collection sewers are deeper than 7 feet a vertical standpipe or stack is required unless otherwise provided for on the Plans. The standpipe or stack does not require concrete encasement; it shall be uniformly supported by compacted backfill.

E. Bedding
1. Sanitary sewer line bedding and embedment material shall comply with ASTM D-2321, Class I or II.
2. Bedding is required to bring the trench bottom up to grade. Bedding material should be placed to provide uniform and adequate longitudinal support under the pipe. Blocking should not be used to bring the pipe to grade. Bell holes at each joint should be provided to permit the joint to be assembled properly while maintaining uniform pipe support. A compacted depth of 4 to 6 inches is general sufficient bedding thickness. In trenches which have natural materials of fine grains, and in conditions where migration of trench wall material into bedding material can be anticipated, either wide trench construction or well graded bedding material without voids should be used.
3. The most important factor affecting pipe performance and deflection is the haunching material and its density. Material should be placed and consolidated under the pipe haunch to provide adequate side support to the pipe while avoiding both vertical and lateral displacement of the pipe from proper alignment. Where coarse materials with voids have been used for bedding, the same coarse material should be used for haunching and consideration shall be given to using wide trench construction. Haunching is placed up to the pipe spring line.

F. Backfill
1. Initial backfill (pipe embedment) shall be completed to a point at least 12 inches over the top of the pipe utilizing Class I or Class II materials as defined in ASTM D-2321.
2. All Trench backfill above pipe embedment shall conform to the requirements of Class III material (or better) as defined in ASTM D-2321.
3. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road or highway shoulders.
4. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the embedment material then the balance of the backfill shall be placed in twelve inch (12") layers with compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.
5. If flooding, jetting or puddling is employed for compaction, care should be taken to prevent drainage and flotation of the pipeline. Saturation should not be used during freezing weather. Erosion of support at the pipe sides and bottom by water jetting should be prevented. Apply only enough water to give complete saturation. Allow time for the saturated soil on each layer to dewater and solidify until it will support the weight of workers.
6. Take care to avoid contact between the pipe and compaction equipment. Do not use compaction equipment directly over the pipe until sufficient backfill has been placed to ensure that such equipment will not damage or disturb the pipe.
7. At least 30 inches of cover over the top of the pipe should be provided before the trench is wheel-loaded. At least 48 inches of cover should be provided before using mobile trench compactors of the hydro hammer or impactor type.

8. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use of this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

G. Street Surfaces
1. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to marking the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, unless otherwise provided.
2. On gravel or limestone, surfaced streets, the trench shall be filled as otherwise specified up to within 4 inches of the surface of the street unless otherwise called for on the Plans. The trench shall then be filled with gravel or limestone, as ordered by the Engineer, to a point approximately 1 inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or limestone as ordered by the Engineer.
3. On concrete streets the trenches shall be filled as otherwise specified within 6 inches of the surface of the street unless otherwise call for on the Plans, and then filled with flexible base to a point approximately 1 inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient flexible base and install concrete of the thickness ordered by the Engineer.
4. On asphalt surfaced streets, the gravel or limestone base shall be placed as stated above. At such time as the gravel or limestone base shall be leveled smooth approximately one inch below the existing asphalt surface, the new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

H. Pipe Crossing Trenches
1. Where any pipe crosses a trench, such as sewer pipe, water or gas pipe, having an exposed joint in the trench, and in the opinion of the Engineer the pipe will not safely span the trench without danger of breaking, it must be supported with a reinforced concrete beam constructed in the following manner: A trench under said cross pipe shall be opened up to a point varying from two (2) to six (6) feet back from the sides of the main trench as the Engineer may direct, so that a timber box may be placed around the pipe and supported by two (2) struts, one on each side of the trench, and resting on a plank across the bottom of trench, underneath the line and of such dimensions as is necessary, to properly support the ends of the beam and pipe which it carries. The width of this box shall be twice and the depth, not to exceed 12", shall be three times the outside diameter of the pipe supported. The box shall then be filled with 3000 psi concrete with a sufficient number of bars of reinforcing steel placed one (1) inch above bottom of box extending the entire length thereof, to provide an area of steel equal to one percent of the sectional area of concrete in the beams. The timber used as forms and struts must be left in the trench.
2. Should it become necessary to change the position of such pipe, conduit or structure, the Engineer shall be notified at once of the locality and circumstances and shall thereupon give directions as to what shall be done, and the Contractor shall conform thereto, and shall be paid (upon the estimate of the Engineer) for materials furnished and for the labor performed upon such change, insofar as it may be additional to that contemplated. The Contractor shall be responsible for injuries to persons and property, for all damage to any pipe, conduit, sewer or other structures injuriously affected by the work, and the Owner shall not be liable thereof.

I. Jacking, Boring & Tunneling
1. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.

2. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.

a. Jacking

1) If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.

2) Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

3) Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.

4) The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support of back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.

5) The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.

6) The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans.

7) If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.
8) When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.
9) Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.
10) The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

b. Boring
1) The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.
2) This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.
3) In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter.
4) Allowable variation from line and grade shall be as specified under "Jacking". Over cutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.

c. Tunneling
1) Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.
2) The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".
3) The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.
4) The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.
5) Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.
6) If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.

J. Clean Up
1. Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.

2. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.

K. Water Line Crossing

1. **Water line/new sewer line separation**: When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel waterlines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following guidelines will apply.
   a. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.
   b. Where a sanitary sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron, or PVC with a minimum pressure rating of 150 psi an absolute minimum distance of six inches between outside diameters shall be maintained. In addition, the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.
   c. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe, or concrete pipe with gasketed joints, a minimum two-foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.
   d. Where a sewer crosses over a waterline, all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five feet intervals with spacers or be filled to the spring line with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

2. **Water Line/manhole separation**: Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine-foot separation distance cannot be achieved, a carrier pipe may be used where appropriate.

3.2 MANHOLES & CLEANOUTS

A. Manholes

1. Manhole covers shall have the designation "SEWER" on top.
2. All concrete segmental units shall be saturated with water before laying and shall be damp but free from surface water when laid.
3. All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar. Manhole inverts shall be carefully constructed to maintain the proper velocities

through the manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to a smooth clean surface.

4. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of 2 inches per foot.
5. Circular precast sections shall be provided with a rubber O-Ring to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.
6. Stubs shall be provided in manholes at the locations shown on the plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.
7. Manhole installation shall be in strict compliance with the manufacturers recommended installation procedures when precast or pre-molded units are used.
8. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.
9. Backfilling around manholes shall not begin until concrete base has cured for 24 hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in 12-inch layers to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
10. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.
11. Construct chimneys using precast concrete rings to bring manholes to finished grade.
12. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frames.
13. Drop manholes shall be constructed where called for in the construction plans and/or where sewer lines enter the manhole higher than 24 inches above the manhole invert. On drop manholes, the invert shall be fitted to prevent solids deposition. A drop pipe should also be provided for a sewer line entering a manhole more than 24 inches above the invert.
14. Cleanouts are required were shown on the plans and on all onsite 6-inch and 4-inch sanitary sewer lines. Spacing shall be every 100ft measured from the upstream entrance of the cleanout.

3.3 SERVICE CONNECTIONS

A. Locate all service connections as shown on Plans and layout with an approved plug. The exact location of all service connections shall be established in the field by Owner's Representative. Contractor shall locate all service connections on his as-built drawings.

B. Stacks shall be provided wherever top of the sewer is 8' - 0" or greater below the surface of the ground. Stacks shall be in accordance with details shown on Drawings.

3.4 TESTS

A. All pipe installations shall be tested in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.
   1. Low Pressure Air Test
      a. After completing backfill of a section of sewer line the Contractor shall, at his expense, conduct a Line Acceptance Test using low pressure air. The test shall be performed using stated equipment according to the stated procedures and under the observation of the Engineer.

2. Equipment
   a. The equipment shall meet the following minimum requirements:
      1) Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
      2) Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking.
      3) All air used shall pass through a single control panel.
      4) Three individual hoses shall be used for the following connections.
      5) From the control panel to pneumatic plugs for inflation.
      6) From the control panel to the sealed line for introducing the low-pressure air.
      7) From the sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
3. Procedures
   a. All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
   b. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs have been checked by the above procedures, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected, the portion of the line being tested shall be termed "Acceptable" if that portion of the line does not lose air at a rate greater than 0.0015 cfm per square foot of internal pipe surface when tested at an average pressure of 3.0 psig greater than the back pressure. This back pressure is that which is exerted by ground water that may be over the invert of the pipe at the same time as of the test. The above requirements shall be accomplished by performing the test as follows:
   c. The minimum time required (in minutes for the pressure to decrease from 3.5 to 2.5 psig - greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time computed by the following equation:

      T = 0.0850(D)(K)/(Q), where T = time for pressure to drop 1.0 pounds per square inch gauge in seconds
      K = 0.00049DL, but not less than 1.0
      D = average inside diameter in inches
      L = length of line of same pipe size in feet
      Q = rate of loss, assume 0.0015 ft3/min/sq ft internal surface

   d. In areas where ground water is known to exist, the Contractor shall install a 1/2-inch diameter capped pipe nipple approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Tests, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height (in feet) of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic tube. The height shall be divided by 2.3 feet to re-establish the pounds of pressure that will be added

to all readings.

4. Results
   a. If the installation is determined unacceptable by the above test, the Contractor shall determine, at his own expense, the source of the leakage, he shall then repair or replace all defective materials and/or workmanship.

B. Manhole Testing
1. Upon completion of installation, each manhole will be visually inspected to ensure the watertight integrity. All manholes on the project shall be vacuum tested in accordance with ASTM C 1244, latest edition, or otherwise tested in a manner preapproved by the Engineer. Manholes shall be tested for leakage separately and independently of the wastewater lines.
   a. In Wet Ground Conditions
      1) The ground shall be water-jetted around the manhole to ensure a positive head of water; and that after completely saturating the earth surrounding the manhole, a visual inspection shall be made and the manhole shall be found to be bottle tight. If any seepage appears, the manhole will be deemed to have not passed the test. In Dry Ground Conditions
      2) All wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes a wetting period of 24 hours may be used prior to testing in order to allow saturation of the concrete. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Alternative test methods must ensure compliance with the above allowable leakage.
      3) Should any manhole not pass this test, it shall be resealed and retested at the Contractor's expense until satisfactory test results have been achieved.

C. Hydrostatic Test for Force Mains
1. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage.
2. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.
3. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.

   $L = (S)(D)(P^{0.5}) / 133{,}200$, where L = leakage in gal/hr
   S = length of pipe in ft
   D = inside diameter of pipe in inches
   P = pressure in pounds per square inch

4. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.

D. Deflection Test
   1. The Contractor shall provide all necessary equipment and shall perform all required work to complete a deflection test on all gravity sanitary sewer lines installed.
   2. Each sanitary sewer line is to be tested for deflection after the backfill has been in place for at least 30 days. The allowable deflection is not to exceed 5%; therefore, the mandrel, rigid ball, etc. used should be sized to 95% of the inside pipe diameter. The test shall be performed without mechanical pulling devices. Any lines with a deflection greater than the allowable are to be replaced.

END OF SECTION 33 33 13

SECTION 33 41 00 - STORM SEWERS AND APPURTENANCES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

A. This section covers storm sewers, culverts, manholes, headwalls, inlets, junction boxes and miscellaneous items indicated in connection with the storm sewer system, complete. Excavation, trenching and backfilling are covered under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES.

1.2 SUBMITTALS

A. Submit product data and shop drawings for ALL items to be installed.

B. Refer to Section 01 33 00 for submittal procedures.

1.3 MEASUREMENT AND PAYMENT

A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS FOR STRUCTURES

A. Precast Concrete Structures
   1. **Unless otherwise specified, only precast concrete structures shall be installed**. Precast structures shall be traffic duty. Concrete for precast structures shall have a design strength of 4500 psi at 28 days. Precast structures shall be monolithic in design. Reinforcing steel shall be Grade 60 and shall meet ASTM A615.

B. Mortar
   1. Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of Portland Cement and two parts of sand. The Portland Cement shall conform to the requirements of Federal Specification SS-C-192, Type I or II. The sand shall conform to the requirements of AASHO Specification M-45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to ten percent (10%) of the volume of cement used. Hydrated lime shall conform to the requirements of Federal Specification SS-L-351, or ASTM Specification C-141. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but shall in no case exceed six gallons of water per sack of cement. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within thirty (30) minutes from the time the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar bead on the outside shall be protected for such period as is necessary to obtain satisfactory curing.

C. Cast Iron
   1. Cast iron shall conform to ASTM Standard Specification A 48, latest edition, for Class 20 gray cast iron. Cast iron shapes shall conform to the dimensions shown and shall be clean

and perfect, free from sand or blow holes, or other defects. Castings shall be factory coated with asphaltum varnish. Twenty-three and one-half inch (23-1/2") manhole covers will be used for sewers forty-eight inches (48") diameter or less. Thirty-two-inch (32") manhole covers will be used for sewers in excess of forty-eight inches (48") in diameter.

D. Brick

1. **Brick structures shall only be used when specifically indicated on the drawings**. All structures shall be constructed, complete with covers in accordance with the details shown on the Drawings. Structures shall be constructed of solid precast segmental concrete masonry units or circular sections specially cast for use in manhole construction.

a. When Structures are to be constructed of brick, materials shall conform to the following:

Concrete:	As specified in the concrete specification.
Brick:	ASTM 662, Grade MW.
Segmental Concrete:	ASTM C139, except as modified herein. 1) Curing: Steam cured for at least 8 hours 2) Minimum Thickness: Upper 12 feet of manhole - 8 inches; Portion below 12 feet - 12 inches
Circular Precast Sections:	ASTM C478
Mortar:	1) Portland Cement - ASTM C150, Type II 2) Hydrated Lime - ASTM C207, Type S 3) Sand - Concrete Sand (fine aggregate which has been sieved through an 8-mesh screen 4) Volumetric Proportions - 1-part Portland Cement, 1/2-part hydrated lime, 3 parts sand 5) Mixing - Cement, lime, and sand shall be thoroughly mixed dry and only enough water added to form a mortar of the proper consistency.
Castings:	1) Iron - ASTM A 48 2) Coating - Hot asphaltum varnish applied at the foundry.

2.2 PIPE FOR CULVERTS AND STORM DRAINS

A. Pipe for storm drains and culverts shall be reinforced concrete pipe (RCP), ASTM C 76, Class III, unless otherwise indicated. Where HDPE (High-Density Polyethylene) is specified, the joints shall meet ASTM F477 and ASTM D3212 (watertight joints). All pipes shall have a smooth interior.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. All concrete segmental units shall be saturated with water before laying and shall be damp but free

from surface water when laid.

B. All mortar shall be used within 30 minutes after mixing. Mortar which has begun to be taken on initial set, shall be discarded and shall not be mixed with additional cement or new mortar. All segmented concrete manholes shall be plastered on all outside surfaces and three feet (3') above the invert on all inside surfaces with mortar not less than one-half inch (1/2") thick. Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole with no increase in the velocity in the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large radius of curve as practicable. All inverts shall be troweled to smooth clean surface. Concrete filling between the sewer invert and walls of manholes shall be flush with top edges of the inverts and slope up from the invert at the rate of two inches (2") per foot. Circular precast sections shall be provided with a mastic gasket to seal the joints between sections. After the sections are in place, the outside of each joint shall be plastered with cement mortar.

C. Piping shall be constructed of the materials specified in this section, and in the manner indicated on the Drawings. Pipe shall be laid true to the grades shown on the Drawings. Any line in which opening or faulting of the joints occurs during backfill or before final inspection and acceptance, such that infiltration of material or a change in flow characteristics results, must be repaired or replaced to the satisfaction of the Engineer. Under no circumstances shall pipe be laid on unsuitable soft material, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and dewatering of trenches during construction shall be borne by the Contractor. Any section of the pipe already laid that is found to be defective or damaged shall be taken up and re-laid or replaced as directed by the Engineer immediately, without additional cost to the Owner.

3.2 INSTALLATION OF CONCRETE PIPE AND PRECAST CONCRETE BOX CULVERT

A. Laying Pipe

1. The laying of pipes on the prepared foundation shall be started at the outlet and with the spigot or tongue ends pointing in the direction of flow and shall proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades. The Contractor shall furnish and place in position all the necessary batter boards for controlling the work. The batter boards shall be of sufficient size timber and shall be substantially supported. The boards and all location stakes must be properly maintained in place. The Contractor shall also furnish, at his own expense, good sound twilled lines for use in giving lines and grades and necessary plummets and graduated poles of an approved form.

2. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trenches without disturbing the prepared foundation and the sides of the trench. The ends of the pipe shall be carefully cleaned before the pipes are placed. As each length of pipe is laid, the mouth of the pipe shall be protected to prevent the entrance of earth or bedding material. The pipes shall be fitted and matched so that when laid in the bed they shall form a smooth, uniform conduit. Shape trench bottom and perform excavation as specified under SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES. Shore and sheet as specified in SECTION 02150 - TRENCH SAFETY per Plans, and referenced documents.

B. Joints in Concrete Pipe

1. Unless otherwise specified, joints in reinforced and unreinforced concrete pipe, shall either be neoprene or rubber gasket joints as hereinafter described. Cold compound joints shall only be allowed when specifically noted in the specifications or contract drawings.

C. Neoprene or Rubber Gasket Joints

1. Joints made with neoprene, rubber, or other similar material that has been approved by

the Engineer will be acceptable for use with reinforced or non-reinforced concrete pipe, either tongue and groove or bell and spigot. The ends of the pipe must be accurately made and designed for use with the gaskets. The type of joint and the gasket must have the approval of the Engineer and may be submitted to the Engineer for approval prior to submitting bids for work on which its use is intended. The joint material and workmanship shall be such as to provide a watertight joint. Joints shall, unless otherwise specified, be pointed on the outside with cement mortar.

D. Bell and Spigot Pipe – Cold Compound Joints
   1. The inside of the pipe bells and the outside of the spigot ends shall, while dry, be completely coated with joint primer. This coating shall be applied sufficiently in advance so that the primer will be thoroughly dry when the pipe is laid. Pipe twenty-four inches (24") and larger shall be primed at the point of manufacture. Apply a fillet of compound on the bottom half of the inside of the bell, press enough dry twisted jute into the compound to pass around the pipe and lap at the top and shove home the spigot of the pipe. Bring the jute around the pipe, firmly caulk into place. The jute should be sufficient to fill one-fourth (1/4) the depth of the bell. Fill the remaining three-fourths (3/4) of the depth of the bell with compound, taking care to leave no voids and provide sufficient compound to form a fillet sloping forty-five degrees from the outer end of the bell to the barrel of the next pipe.
   2. Compound used for these joints shall be a well-known brand of material of proven worth, uniform in consistency and approved by the Engineer as being equal to RAM-NECK. Primer shall be of the type recommended by the manufacturer of the compound used.

E. Tongue and Groove Pipe – Cold Compound Joints
   1. Unless otherwise specified, this type of joint shall be used for tongue and groove pipe joints not made with approved neoprene or rubber gaskets. The compound and primer shall be the same as described herein for use with bell and spigot pipe.
   2. Both ends of the pipe shall, while clean and dry, be coated with primer on all surfaces that will be in contact with the compound. The primer shall be allowed to dry before the pipe is laid. Twenty-four inches (24") and larger pipe shall be primed at the factory.
   3. After pipe has been set to proper line and grade in the trench a one-half (1/2") thick layer of the compound shall be troweled or otherwise placed on the groove end of the pipe covering about two-thirds (2/3) of the joint face around the entire circumference. Next the tongue end of the next pipe shall be shoved home with sufficient pressure to make a tight joint. Care shall be taken to avoid leaving ridges of the compound projecting into the pipe in a manner that would obstruct the flow. The Contractor will make the necessary adjustment in the quality and consistency of the compound as the work progresses.
   4. An outside band of the joint compound shall be installed completely around the circumference of the pipe at the joint. This will necessitate digging "bell holes" at each joint. The band shall have a thickness at the center of at least three-quarter inch (3/4) tapering uniformly to nothing approximately three inches (3") each side of the center. Where Class A bedding is used, the band may be omitted on portions of the joint that will be embedded in the cement-stabilized sand bedding.

F. Corrugated Steel Pipe
   1. Fully bituminous coated corrugated steel pipe shall conform to FS WWP 405, Class I or II, Shape 1, 2, 3, with Coating A. Gauge of pipe shall be as indicated on the Drawings.
   2. The space between pipe and connecting bands shall be kept free of dirt and grit so that corrugations fit snugly. Connecting band shall be tapped with soft head mallet of wood, rubber or plastic while being tightened to take up slack and insure tight joint. Fill annular space between abutting sections of fully paved pipe and pipe arch with bituminous material after jointing.
   3. Unless otherwise specified, field joints shall be made with outside bands, each consisting of one or two pieces. Type, size, and gauge of band and size of angles and bolts shall be

as indicated on the Drawings or as applicable for gauge and type of pipe used.

3.3 INSTALLATION OF HDPE PIPE

A. HDPE Drainpipe shall be high-density corrugated polyethylene heavy-duty pipe and shall be manufactured in conformance with the latest AASHTO specifications of M294 Type S and AASHTO M252. (ADS N12 or equivalent are acceptable materials)

B. Joints and Fittings: Pipe and fittings shall conform to AASHTO M294 and AASHTO M252. Couplers shall cover not less than one full corrugation on each annular section of pipe.

C. Bedding Material: Bedding material shall be cement-stabilized sand unless otherwise noted in the plans. **Refer to Specification 31 23 23.16 – Cement Stablized Sand Bedding and Backfill.**

3.4 MANHOLES

A. Installation
   1. Manhole installation shall be in strict compliance with the manufacturer's recommended installation procedures.
   2. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.

B. Stubs
   1. Stubs shall be provided in manholes at the locations shown on the Plans. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.

C. Backfilling
   1. Backfilling around manholes shall not begin until concrete base has cured for twenty-four (24) hours. Backfill using native soil free of foreign objects, stones, concrete, or debris. Backfill in layers not to exceed twelve inches (12") to avoid uneven loading. Do not allow equipment to impact manholes during backfill operations.
   2. Do not backfill above flat areas at top of cone of manholes to allow for installation of concrete chimney.

D. Finishing Manhole to Grade
   1. Construct chimneys using precast concrete rings to bring manholes to finish grade.
   2. Seal both the top and the bottom faces of concrete rings with “RAM-NEK” rope type mastic sealant.

E. Manhole Frames and Covers
   1. Cast iron for manhole frames and covers shall conform to the dimensions shown on detail drawings and shall be clean, free from sand and blow holes or other defects. Manhole covers and Inlet Grates shall include all graphics, logos, and verbiage required by all regulatory agencies having jurisdiction over the project. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frame.

END OF SECTION 33 41 00

SECTION 33 44 19 - STORM WATER MANAGEMENT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 STORM WATER MANAGEMENT

A. "Storm Water Management" shall consist of all requirements to comply with current Texas Commission on Environmental Quality (TCEQ) Texas Pollutant Discharge Elimination System (TPDES) Construction Storm Water Discharge Regulations and Requirements.

1.2 SCOPE

A. The scope of this item includes satisfying the TPDES Permit Regulation including, but not limited to, any permits that shall be obtained and any construction practices, equipment, materials, labor, and structures necessary to conform with these regulations.

1.3 STANDARDS

A. This section will be governed by the regulations of the city and or county have jurisdiction over the project.

B. All provisions, technical specifications, guidelines, intent and construction practices detailed within this handbook will be considered a part of the technical specification and will have full force and effect regarding this project.

1.4 PERMITS

A. The Contractor is responsible for the planning and implementation procedures for storm water pollution prevention plans (SWPPP) for this construction site. The SWPPP shall be fully developed and implemented before submitting a Notice of Intent (NOI) that this project will be covered by the final TPDES general permit requirements.

B. The Contractor shall file the NOI with the TCEQ at least seven (7) days prior to the commencement of construction activities.

C. The Contractor shall also prepare and submit inspection reports pertaining to the Storm Water Management for the City and file the Notice of Termination after the site has been stabilized.

1.5 PAYMENT

A. Storm Water Management will be incidental to all other Bid Items in the bid proposal.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. The Contractor is responsible for all construction activities, structures, etc., associated with implementing the TPDES Permit and the SWPPP. This includes, but is not limited to, filter fabric fences, straw bale fences, temporary hydro-mulch seeding, sodding, inlet protection barriers, etc. that pertain to the intent of this section.

END OF SECTION 33 44 19

SECTION 33 46 16.34 - SUBDRAINAGE SYSTEM FOR SYNTHETIC TURF ATHLETIC FIELDS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

A. Work shall include all labor, materials and equipment to complete the underdrain system as indicated on the Field Subdrainage Plan and as herein specified.

1.2 MEASUREMENT AND PAYMENT

A. There will be no separate measurement and payment for work performed under this section.

1.3 REFERENCES

A. The applicable provisions of the following standards shall apply as if written here in their entirety:
   1. AASHTO - American Association of State Highway and Transportation Officials
   2. ASTM - American Society of Testing and Materials

1.4 SUBMITTALS

A. Electronically submit the product data which shall include as a minimum manufacturer's product data on: drainpipe, fittings and accessories. Material samples shall also be submitted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Perforated Drainpipe: Perforated drainpipe shall be high density corrugated polyethylene heavy duty pipe and shall be manufactured in conformance with the latest AASHTO specifications of M294 Type S and AASHTO M252. (ADS N12 or equivalent are acceptable materials)

B. Joints and Fittings: Pipe and fittings shall conform to AASHTO M294 and AASHTO M252. Couplers shall cover not less than one full corrugation on each annular section of pipe.

C. Bedding Material:
   1. See Specification 32 11 23.23 Free Draining Stone Base for Synthetic Turf Systems

D. Valve Boxes/Cleanouts: 10-inch round with locking top, Ametek or Carson manufactured.

PART 3 - EXECUTION

3.1 PREPARATION

A. The subgrade for the underdrain system shall be completed by the Contractor using laser control within an elevation tolerance of plus 0.00 inch to minus 1/2 inch of the design subgrade elevations

as determined from the Contract Drawings.

B. Subgrade elevations and uniformity shall be verified by a Registered Professional Land Surveyor retained and paid by the Contractor and approved by the Owner. A certified copy of the survey shall be submitted to the Owner and the Engineer within three (3) days after completion.

C. The completed subgrade shall be compacted to a uniform density of no less than 95% of maximum as determined by ATSM Designation D 698-78. The Engineer and the Contractor shall inspect the subgrade prior to construction of the subdrain system. If the system subgrade meets the above specifications, the Contractor may commence construction. It the subgrade is not acceptable; the Contractor shall correct the deficiencies before proceeding.

3.2 INSTALLATION

A. Contractor shall commence the underdrain work upon completion of the prepared subgrade. Subgrade of field shall conform to the grading plan. Contractor shall provide for an elevation tolerance of plus or minus 1/2 inch of the designated subgrade. Certified verification of subgrades shall be provided by the Contractor and approved by the Engineer prior to work commencement.

B. The location of each run of pipe shall be staked out and laser surveyed prior to trenching. Install Geomembrane Liner to bottom and sides of trenches. Extend fabric a minimum of five (5) feet past each side of top of trench on top of the subgrade. All pipe shall be carefully placed in the trenches with bedding material installed per plans and details. The interior of pipes shall be kept free from dirt and debris and when pipe laying is not in progress, open ends of pipes shall be closed by tape or other approved means.

C. All pipes shall be laid to drain in accordance with the plans. All subdrainage piping shall be emptied into the existing catch basin/storm piping configuration at the west end of the playing fields and at the elevation listed per the plans. Perforation into the exiting storm system shall be concrete grouted after installation of pipe.

D. Coordinate trenching and installation with underground irrigation and exiting storm sewer system. If conflicts exist, modify irrigation lines as required and protect the existing storm sewer and catch basins from damage.

E. Remove all excess waste materials and soils off of field and maintain original subgrade elevations. This work is to be accomplished on a daily basis

F. Keep up to date as-built documents, as the job progresses and make available to Engineer and Owner's Representative for inspection at all times. Revise drawings as required to indicate field changes made during installation.

END OF SECTION 33 46 16.34

SECTION 33 71 74 - ELECTRICAL UTILITY SERVICES - UNDERGROUND

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes arrangement with Utility Company for permanent electric service; service provisions; and secondary service entrance from Power Company.

B. Coordination: Contractor shall be responsible for all coordination required for utility installation, connections and inspections.

1.3 REFERENCES

A. Section 26 05 00 – Common Work Results for Electrical.

1.4 SYSTEM DESCRIPTION

A. Utility Company: [_____]

B. System Characteristics: 480Y/277 volts, three phase, four- wire, 60 Hertz.

C. Service Entrance: Underground.

D. Underground Service Provisions: Underground service entrance to building service entrance equipment.
   1. Utility Service-Entrance Conductor Connection: At Utility Company's pad-mounted transformer.

1.5 SUBMITTALS

A. Submit utility service outlet agreement including Utility Company prepared installation drawings.

1.6 QUALITY ASSURANCE

A. Install service entrance in accordance with Power Company's Rules and Regulations.

B. Maintain one copy of each document on site.

1.7 COORDINATION

A. Coordinate with Utility Company, relocation of overhead or underground lines interfering with construction.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

A. Coordinate with Power Company and provide equipment, conduits, manholes and equipment pads in accordance with Power Company directions.

2.2 CABLE TAP BOX

A. Submit two (2) copies of drawings of proposed cable tap box to the designated representative of the Electric Utility for approval prior to fabrication of cable tap box.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arrangements with Power Company shall be made to obtain permanent electric service to the Project.

B. Provide primary service entrance conduits from Power Company terminations. Power Company will connect conductors to transformer and provide primary cables.

C. Provide secondary service entrance conduits and wire from Power Company transformer to building service entrance equipment.

D. Provide raceway enclosures and attachment for metering equipment as required by Electric Utility.

E. Install cast-in-place concrete pad for Utility Company transformer.

3.2 CABLE TAP BOX

A. Conduit Between Transformer and CTB:
   1. Electric Utility requires conduits from padmount transformer to cable tap box. Install conduits in concrete ductbank from secondary opening of the transformer pad to the utility side of the cable tap box. Coordinate conductor installation with Utility Company.
   2. Prior to pouring concrete for conduit between transformer pad and cable tap box pad, obtain inspection and approval of trench by Electric Utility.

B. Conduit Between CTB and Building: Provide underground conduit and cable from tap box to main switchboard. All underground conduit shall be encased in reinforced concrete.
   1. Cable Termination: Terminate all cables on customer side of CTB with NEMA-pattern, two-hole, compression lugs.

3.3 CUSTOMER FAULT PROTECTION

A. General: Provide the following information for each service entrance overcurrent protective device. Electric Utility may furnish forms to be filled out or otherwise stipulate format of submittal. Provide information noted herein plus other items noted in Electric Utility drawings and specifications. Submit all data at least 30 days prior to service cut-in date. Contractor shall obtain device settings from submitted coordination study or, when coordination study not required, as recommended by manufacturer of actual equipment

installed on job site.

B. Coordination Study: Refer to Section 26 20 00 to determine if coordination study is required. When a coordination study is required, Contractor shall obtain and furnish a copy to the Electric Utility. Settings for main circuit breaker(s) shall be taken from coordination study and identified to Electric Utility.

3.4 PRIMARY DUCTBANK INSTALLATION

A. Routing: All proposed conduit for Electric Utility primary cables shall be installed in straight runs, unless otherwise indicated on Electric Utility drawings. Any conduit bends shall be installed with a 20 foot minimum radius, unless indicated otherwise on Electric Utility drawings. Conduit turn-ups into equipment pads and pole pedestals shall have a minimum five (5) foot radius. Conduit turn-ups (bends) determined by Electric Utility to be wrinkled, crumpled, or creased shall be replaced by the Contractor. Any deviations from these requirements shall have written approval from the Electric Utility prior to installation.

B. Conduit: During installation, the minimum depth for a conduit run shall be referenced to the final grade. Type EB rigid PVC conduit encased in red concrete, six (6) inches Inside Diameter. Slope as directed by Electric Utility.

C. Pulling Ribbon: Provide a 3/4 inch duct ribbon with numerical footage markings (Neptco #WP-2500P, or equivalent acceptable to the Electric Utility) in each conduit installed. This pulling ribbon shall extend a minimum of seven (7) feet beyond the end of the conduit.

D. Survey Wire: Provide a #14 American Wire Gage (AWG) or larger aluminum or copper 600 volt insulated conductor in the middle conduit. This conductor shall be electrically continuous from end-to-end of each ductbank. Conductor will facilitate surveying of the ductline by the Electric Utility. Take adequate measures to assure the conductor will be in place until all necessary surveying is completed.

E. Plugs: Conduit ends shall be plugged with a duct cap or other type capping device. The use of rags to plug conduits is prohibited. If the conduit is installed in stages, keep each section of conduit capped until the new section is installed. If, prior to Electric Utility using any conduit, the conduit is found to be blocked, the Contractor shall remove the obstruction, at Contractor expense.

F. Concrete: All cold joint concrete pours shall have four #5 rebar in place before any new concrete is poured; 3 feet-0 inches in length, exposed 1 foot-6 inches.

G. Ductbank Clearance:
1. Customer ductbank or any other non-electric utilities shall not be routed beneath pads for Electric Utility equipment (except for stub-up of Customer secondary ductbank).
2. Hold a one (1) foot minimum vertical clearance between Electric Utility ductbank and all other facilities.
3. Hold a five (5) foot minimum horizontal clearance between Electric Utility ductbank and other facilities running parallel to the ductbank.
4. Electric Utility will not allow joint trenching between electric ductbank and any other underground utilities.

H. Terminal Pole: Delay installation of approximately the last 20 feet of primary conduit installation until the terminal pole location has been staked by the Electric Utility. Install

conduit stub at the terminal pole only after the pole has been set by the Electric Utility. Securely brace the pole before trenching up to it. Contact Electric Utility to obtain schedule and any required observations by E.U. personnel.

I. Slack Secondary Conductor: When Contractor installs secondary conductor from the pole mount transformer to the building service entrance equipment, pull at least seven (7) feet of slack cable. This slack cable will be used by Electric Utility to make cable terminations onto lugs in transformer secondary compartment. Furnish compression body lug to Electric Utility for each service entrance cable.

J. Manholes: Provide manholes per Electric Utility Standards and one 5'x8' manhole per 300 linear feet of primary ductbank.

3.5 INSPECTION

A. Customer Installed: All customer-installed facilities to be used by Electric Utility shall be inspected by the Electric Utility after the conduit is installed, pads are formed, reinforcing rods installed and other work performed, but prior to the pouring of concrete. Contact Electric Utility at least 24 hours in advance, week days, regular business hours, non-holiday.

B. Final Inspection: Final on-site inspection will be made by Electric Utility to verify that all customer installed facilities are in accordance with Electric Utility service agreement specifications and terms and conditions. The customer (or customer's contractor) will be advised of any needed corrections and changes. Perform all corrections and changes as directed by Electric Utility at no additional cost to the Owner

END OF SECTION 33 71 74